Engineering Evaluation of the

Human Research Facility

Refrigerated Centrifuge Prototype

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1.0 Acoustic Test

1.1 Test Objective

Test to verify if the test article can meet the space station requirement for acoustic emission. Test results can also help identify different noise sources for engineering evaluation.

1.2 Test Procedure

Acoustic Meter Data
Manufacture: CEL
Model Number: CEL-493; Calibration Number: M96511
Octave Filter Model Number: CEL-278; Calibration Number: M96511

Battery Check
A battery check should be performed prior to the test. Switch the meter from OFF to BAT and record the level below:

5.6 Volts.

Note: Batteries should be replaced if value is less than 3.4 volts.

A-Weighted Background Noise Check

Background Noise 33 dB(A)

Note: If the background noise exceeds 50 dB(A), then do not proceed with test until the noise level has been reduced to below that.

1.3 Test Results

Mode and Side Determination
Only front side will be monitored for this test. There are two different modes for testing:

Mode 1: Compressor On, Rotor at 2000 RPM
Mode 2: Compressor Off, Rotor at 2000 RPM

dB(A) Front: 63.5 dB(A), Mode 1
dB(A) when rotor at 14000 RPM: 81 dB(A)

Operator: Richard Yao Time: 5:00 am, Jan. 5, 2001

Table 1 shows the two feet measurement results for Mode 1 and Figure 1 shows the test result against the maximum allowed.

TABLE 1 TWO FEET MEASUREMENTS

COLUMN A CENTER FREQUENCY (HZ)	COLUMN B BACKGROUND NOISE (dB LINEAR)	COLUMN C BACKGROUND NOISE + EXPERIMENT NOISE (dB LINEAR)	COLUMN D EXPERIMENT NOISE COLUMNS C - B (dB LINEAR)	COLUMN E FINAL CORRECTED EXPERIMENT NOISE (dB LINEAR)	COLUMN F MAXIMUM ALLOWED NOISE (dB LINEAR)
63	41.0	63.4	22.4	63.4	**64**
125	32.3	63.5	31.2	63.5	**56**
250	36.7	62.1	25.4	62.1	**50**
500	31.8	61.6	29.8	61.6	**45**
1000	31.3	56.1	24.8	56.1	**41**
2000	30.8	56.2	25.4	56.2	**39**
4000	32.2	52.4	20.2	52.4	**38**
8000	30.0	45.5	15.5	45.5	**37**

Mode: Mode 1
Front Side

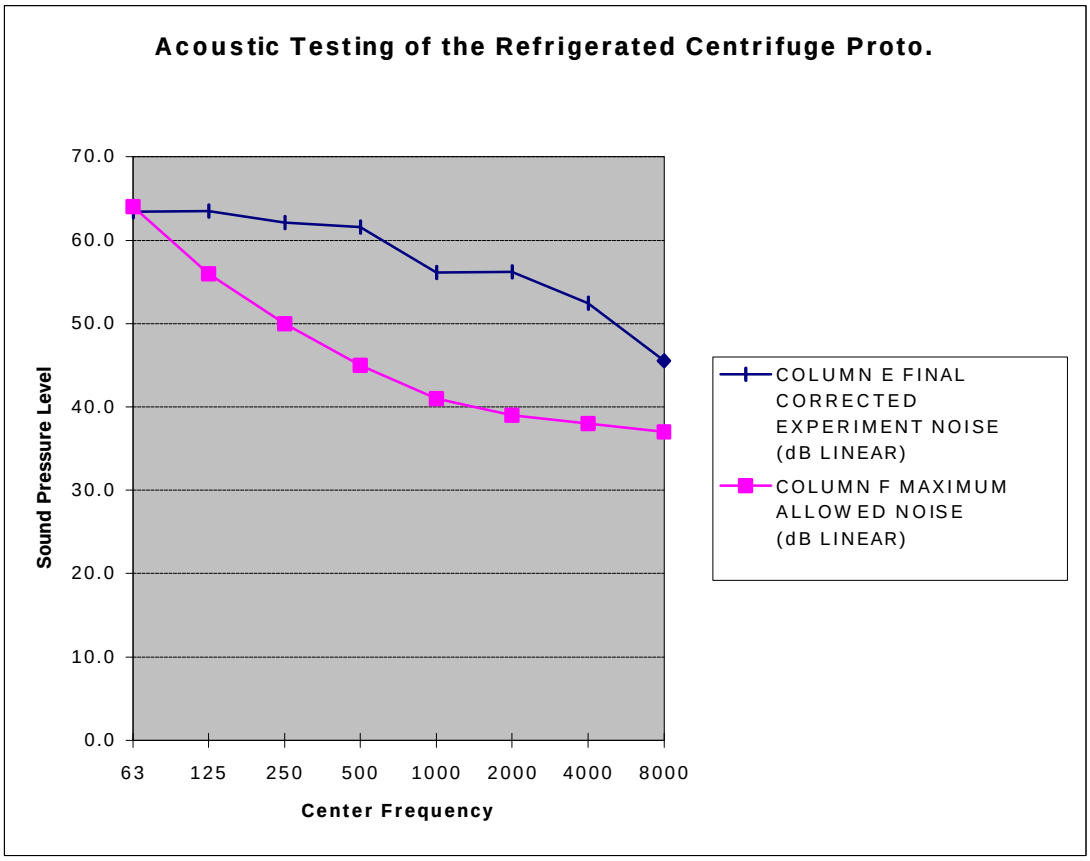


Figure 1

Table 2 shows the two feet measurement results for Mode 2 and Figure 2 shows the test result against the maximum allowed.

TABLE 2 TWO FEET MEASUREMENTS

COLUMN A CENTER FREQUENCY (HZ)	COLUMN B BACKGROUND NOISE (dB LINEAR)	COLUMN C BACKGROUND NOISE + EXPERIMENT NOISE (dB LINEAR)	COLUMN D EXPERIMENT NOISE COLUMNS C - B (dB LINEAR)	COLUMN E FINAL CORRECTED EXPERIMENT NOISE (dB LINEAR)	COLUMN F MAXIMUM ALLOWED NOISE (dB LINEAR)
63	41.0	63.4	22.4	63.4	**64**
125	32.3	63.5	31.2	63.5	**56**
250	36.7	62.1	25.4	62.1	**50**
500	31.8	61.6	29.8	61.6	**45**
1000	31.3	56.1	24.8	56.1	**41**
2000	30.8	56.2	25.4	56.2	**39**
4000	32.2	52.4	20.2	52.4	**38**
8000	30.0	45.5	15.5	45.5	**37**

Mode: Mode 2

Front Side

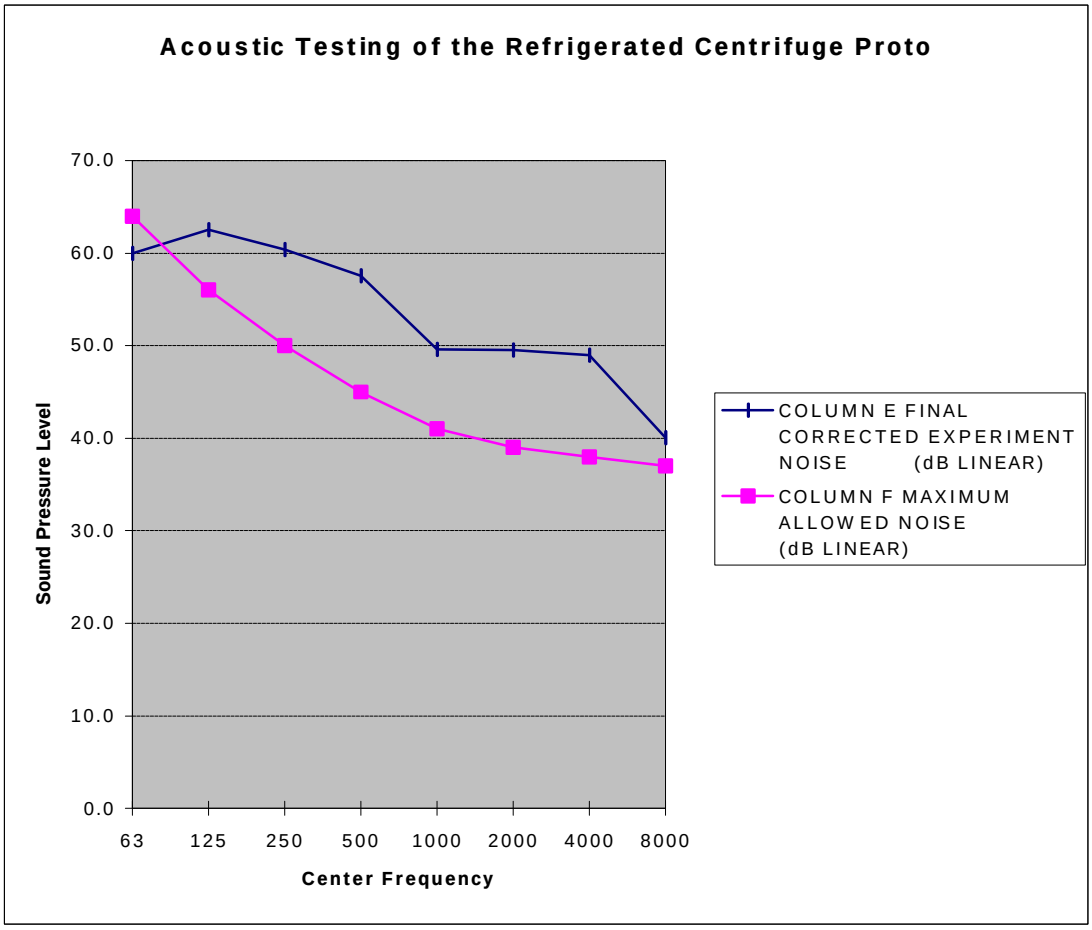


Figure 2

1.4 *Conclusion*

From the test results, it can be seen that although the overall noise level (63.5dBA) is lower than the maximum allowed for on ISS, for one hour operation (65dBA), the acoustic emission of the RC prototype exceeds the maximum allowed at every frequency range. It should also be noticed is that this test is done in an open environment rather than an enclosed rack, the noise from the common fans are overwhelming. Therefore, the test results cannot represent the rack mounted configuration.

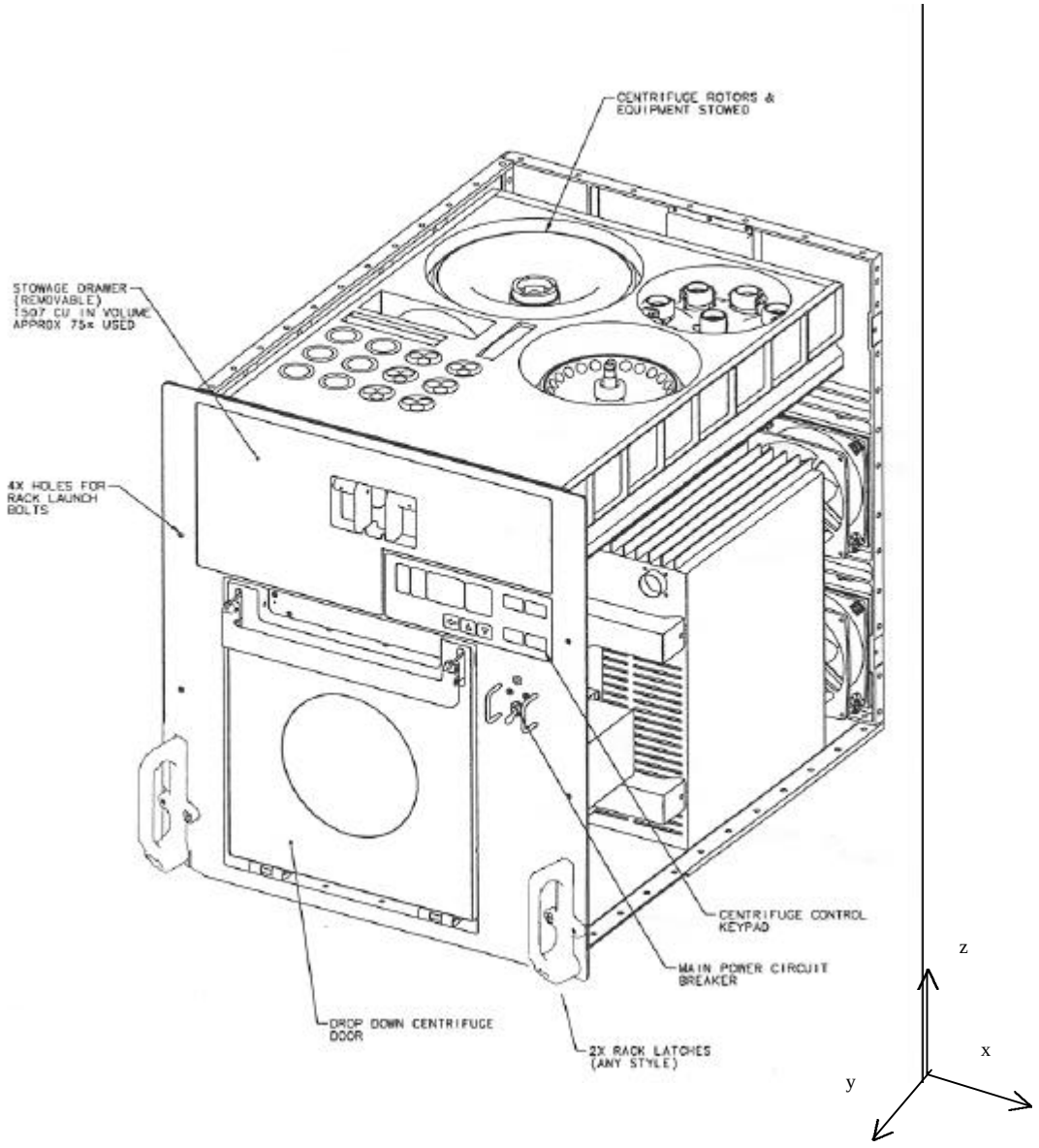
2.0 Vibration Test

2.1 *Test Objective*

The purpose of the vibration test is to test the structural integrity of the centrifuge design.

2.2 *Test Procedure*

The vibration test was performed at Marshall Space Flight Center in Huntsville Alabama per TPS 7E0020096, December 13th-14th, 2000. An Acceptance Vibration Test (AVT) and a Qualification Vibration Test (QAVT) were performed on the prototype unit. Diagram 2.2 illustrates the coordinate system used for this test.



2.2.1 Acceptance Random Vibration Test

The AVT test is done in all three axes for a duration of 60 seconds per axis. A full functional test was done before the start of the AVT, and at the conclusion of the AVT. Abbreviated functional test were performed in between each axis tested. Table 2.2.1 defines the test levels.

Table 2.2.1: AVT Test Levels

Frequency Range (Hz)	**Minimum Power Spectral Density (g^2/Hz)**
20	.010
20-80	+3.0
80-350	.04
350-2000	-3.0
2000	.007
Composite	6.1

2.2.2 Qualification Acceptance Vibration Test

The QAVT test is done in all three axes for a duration of 60 seconds per axis. A full functional test was done before the start of the AVT, and at the conclusion of the AVT. Abbreviated functional test were performed in between each axis tested. Table 2.2.2 defines the test levels.

Table 2.2.2: QAVT Test Levels

Frequency Range (Hz)	**Minimum Power Spectral Density (g^2/Hz)**
20	.017
20-80	+3.0
80-350	.087
350-2000	-3.0
2000	.012
Composite	7.9

2.3 Test Results

One anomaly was noticed after performing the z axis during the QAVT. The solenoid that is responsible for locking and unlocking the centrifuge door was stuck in the open position. This anomaly is due to a misalignment of the door and the lid locking mechanism. Other than this one anomaly, the prototype centrifuge successfully passed all other vibration testing.

2.4 Conclusion

The hardware performed exceptionally well during all vibration testing. The anomaly with the solenoid will be corrected by aligning the locking mechanism properly during assembly of the flight units.

3.0 Sinusoidal Resonance Survey

3.1 *Test Objective*

The purpose of the Sinusoidal Resonance Survey is to determine the fundamental resonance frequencies of the test article.

3.2 *Test Procedure*

The test was conducted in the x axis, at a sweep rate of one octave per minute from 5 to 200 Hz, one sweep up and down, with an input not to exceed 0.25 g zero to peak. An accelerometer was mounted the back left, bottom corner, at an accessible hard point on the centrifuge near the center of gravity (CG). The output of this response accelerometer was monitored so as not allow the hardware to experience more than 0.5 g peak. The input acceleration level shall be monitored by an accelerometer mounted as close as possible to the test fixture/hardware interface.

3.3 *Test Results*

The test shows that there is a resonance frequency at 7 Hz. The test had to be aborted at approximately 7 Hz due to a large spike in the accelerometer readout. The spike was a result of the internal components of the compressor resonating back and forth causing them to hit the internal wall of the compressor housing.

The input was decreased to 0.098 g, and the displacement was changed to 0.0767 inch and the test was restarted. Again, a loud banging was heard and the test was aborted. The test was restarted at the upper limit of 250 Hz, and run backwards, down the scale. This was done to determine the exact frequency at which the compressor was failing. It was determined to be 7 Hz. The data from this test is provided in an attachment labeled Appendix A.

3.4 *Conclusion*

The internal components of the compressor are mounted on springs. These springs are used to decrease the acoustic emission of the compressor. In an effort to correct the sinusoidal resonance frequency issues, a new design part will be added internal of the compressor housing incorporating springs to absorb the x and y energy. Figure3-4 is a preliminary design that is being considered. In order to determine the best design solution, a sine sweep needs to be performed in the z axis.

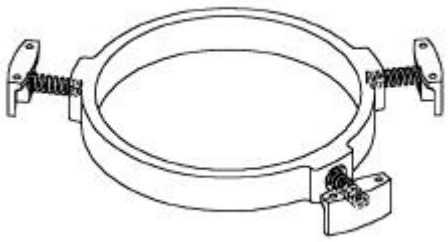


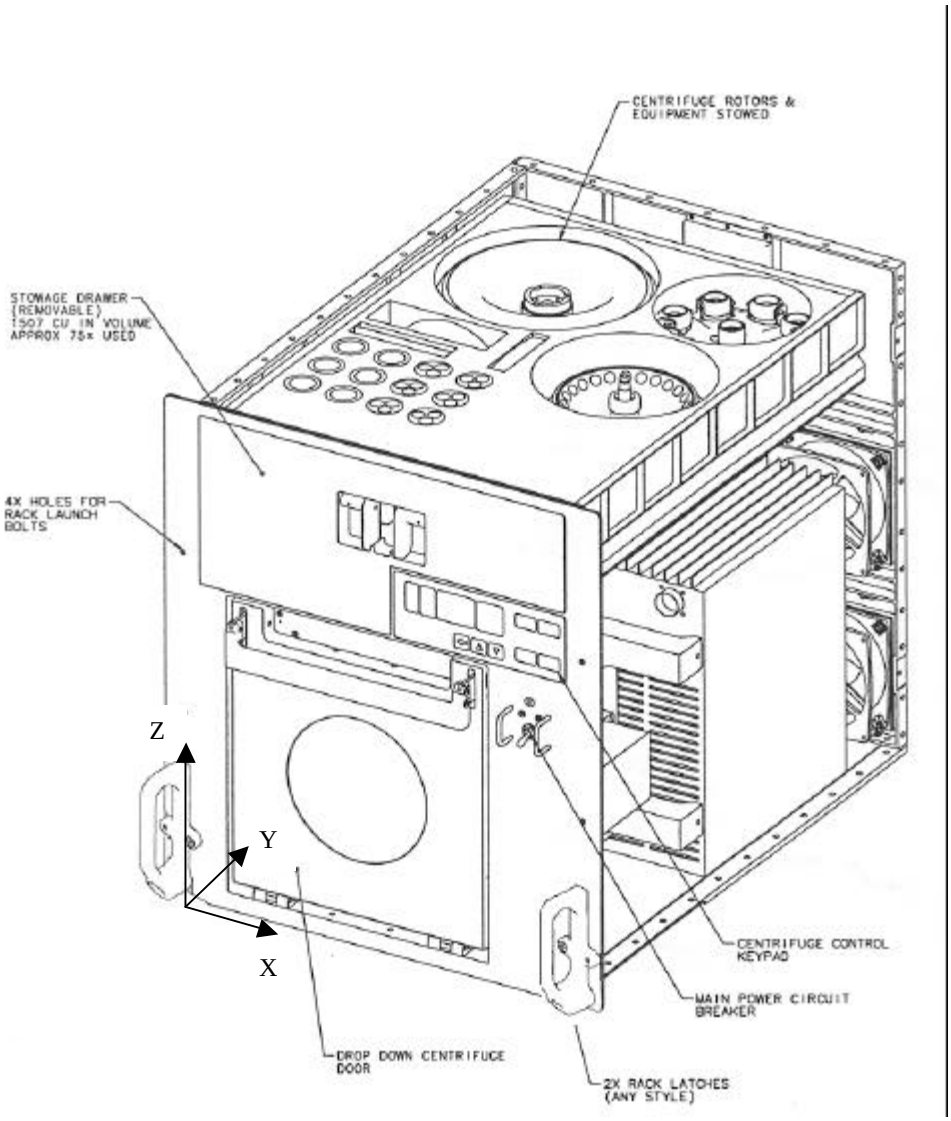
Figure 3.4: Spring Support Assembly

4.0 Weight and Center of Gravity

4.1 *Test Objective*

The purpose of the weight and cg test is to verify to verify that the weight and CG meet space station requirement. The results are also be used to verify the model used for the structural analysis.

4.2 *Test Procedure*



4.3 *Test Results*

The total weight of the prototype unit is 74.9 Kg (165.13 lbs). The maximum allowable weight for a 12 PU drawer is 87.09 kg (192 lbs).

The center of gravity is (20.49, 31.11, 22.19), in cm. The cg is within the allowable cg of a 12 PU drawer with 3 sets of slides.

4.4 *Conclusion*

The mass and cg of the unit are within the requirements as defined in the Program Requirements Document (LS71000).

5.0 Electromagnetic Interference Testing

5.1 *Test Objective*

The purpose of this test is to evaluate the levels of radiated and conducted emissions.

5.2 *Test Procedure*

The radiated emissions test, RE-02, and the conducted emissions tests, CE-01, CE-03, and CE-07 were performed in accordance with SSP30238 Rev D, per TPS 7E0020084. The results were compared to the limits of SSP 30237, Revision E. Documentation and complete testing charts are included in an attachment labeled Appendix B.

The chamber temperature was set to –20 deg C for continuous compressor operation, and the rotor speed was set to 6000 rpm**.** The test configuration is shown below in diagram 5.2.

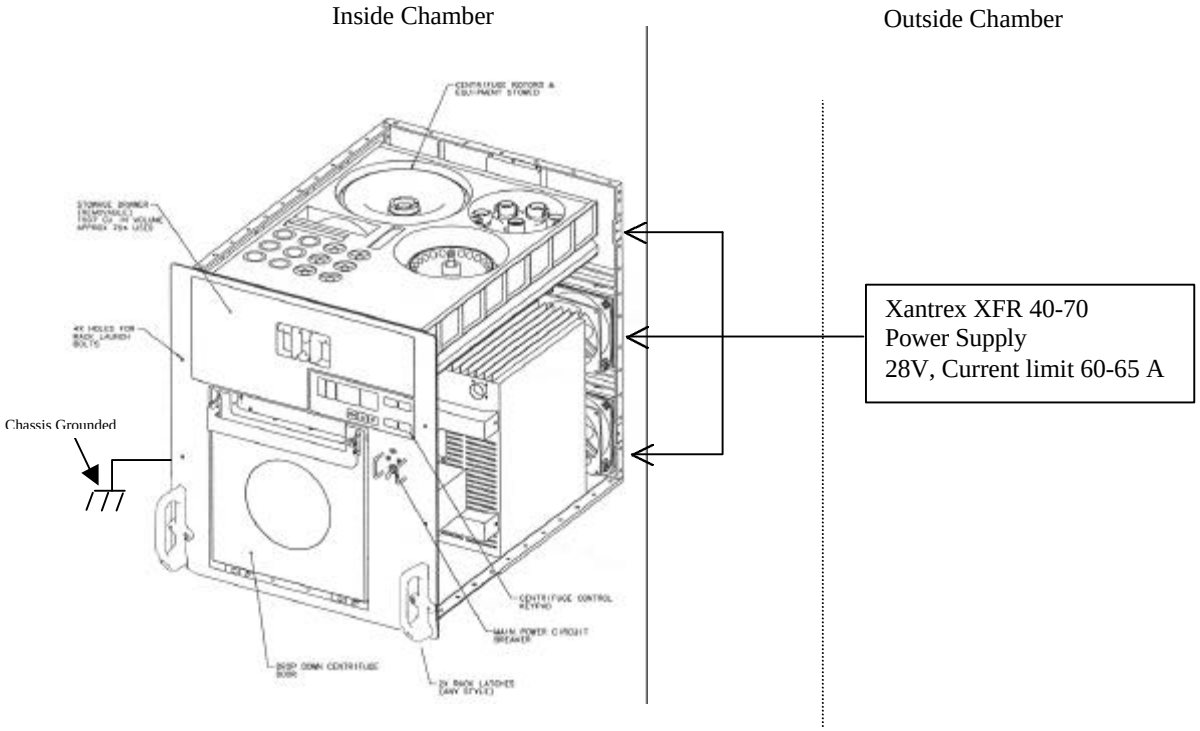


Figure 5.2: EMI Test Configuration

5.3 Test Results

5.3.1 RE-02

RE-02 measures the radiated emissions from a frequency range of 14 kHz to 15.5 GHz. EMI exceedances are documented as follows:

Frequency (MHz)	Amplitude (dBuv/m)	Exceedances[1]
0.01486	60.7	4.7
0.0152	62.4	6.4
0.01555	67.2	11.2
0.01614	66.3	10.3
0.0165	65.7	9.7

[1]Exceedances are calculated from the amplitude versus the limits specified in SSP 30237, Revision E.

5.3.2 CE-01

CE-01 measures the conducted emissions on the hot and return leads of the HRF Centrifuge main power from a frequency range of 3 Hz to 15 kHz. No exceedances were observed from the test:

5.3.3 CE-03

CE-03 measures the conducted emissions on the hot and return leads of the HRF Centrifuge main power from a frequency range of 50 kHz to 50 MHz. The exceedances are documented as follows.

HOT LEAD		
Frequency (MHz)	Amplitude (dBuA)	Exceedances[1]
0.07835	97.3	5.0
0.1638	96.4	10.2
RETURN LEAD		
Frequency (MHz)	Amplitude (dBuA)	Exceedances[1]
0.07772	99.6	7.3
0.1638	95.6	9.4

[1]Exceedances are calculated from the amplitude versus the limits specified in SSP 30237, Revision E.

5.3.4 CE-07

CE-07 measures the conducted emissions on start up transients of the HRF Centrifuge.

5.4 Conclusion

5.3.1 RE-02

An investigation of the EMI failure has been initiated and preliminary results indicate that the stowage drawer and centrifuge chamber drawer will need conductive coating and EMI gaskets to reduce radiated emissions of the HRF Centrifuge.

5.3.5 CE-01

Because the HRF Centrifuge did not demonstrate any failures for this test, no changes or modifications are required.

5.3.6 CE-03

Based upon the testing results, the HRF Centrifuge power filtering will need to be addressed. The most significant contribution to the CE-03 failure is during compressor operation that utilizes Pulse Width Modulation circuitry for inverter operation to operate the compressor. Proper filtering will be addressed and implemented into the flight design.

5.3.7 CE-07

Based upon the testing results, the HRF Centrifuge power filtering will need to be addressed. Current recommendation is to add appropriate LC circuits to smooth the startup transient.

6.0 Duty Cycle Test

6.1 *Test Objective*

The purpose of this test was to determine the on/off cycle of the compressor. This data is necessary for thermal and power analysis.

6.2 *Test Procedure*

The rotor speed was set to 2000 RPM, and the chamber temperature was set to +4 °C. The test was performed for a duration of 30 minutes and the duration of each cycle was recorded. In addition to the cycle time, the compressor can temperatures and the internal door temperatures were recorded.

6.3 *Test Results*

The test results are provided in Table 6.3.

Table 6.3: Compressor Duty Cycle

Test Duration (minutes)	Compressor On (minutes)	Compressor Off (minutes)	Outside door decal (C)	Outside Door Lexan (C)	Inside Door (C)	Compressor (C)
0:07:09	0:07:09		25.00	22.00	9.60	52.80
0:08:40		0:01:31				
0:11:05	0:02:25		25.00	22.00	8.70	54.30
0:12:03		0:00:58				
0:14:51	0:02:48		26.00	21.00	8.10	55.30
0:16:19		0:01:28				
0:18:36	0:02:17		25.00	21.00	7.70	55.60
0:20:06		0:01:30				
0:22:25	0:02:19		25.00	20.00	7.30	56.00
0:23:52		0:01:27				
0:26:15	0:02:23		25.00	20.00	7.10	57.70
0:27:43		0:01:28				
0:30:02	0:02:19		25.00	19.00	6.90	57.00

6.3 *Conclusion*

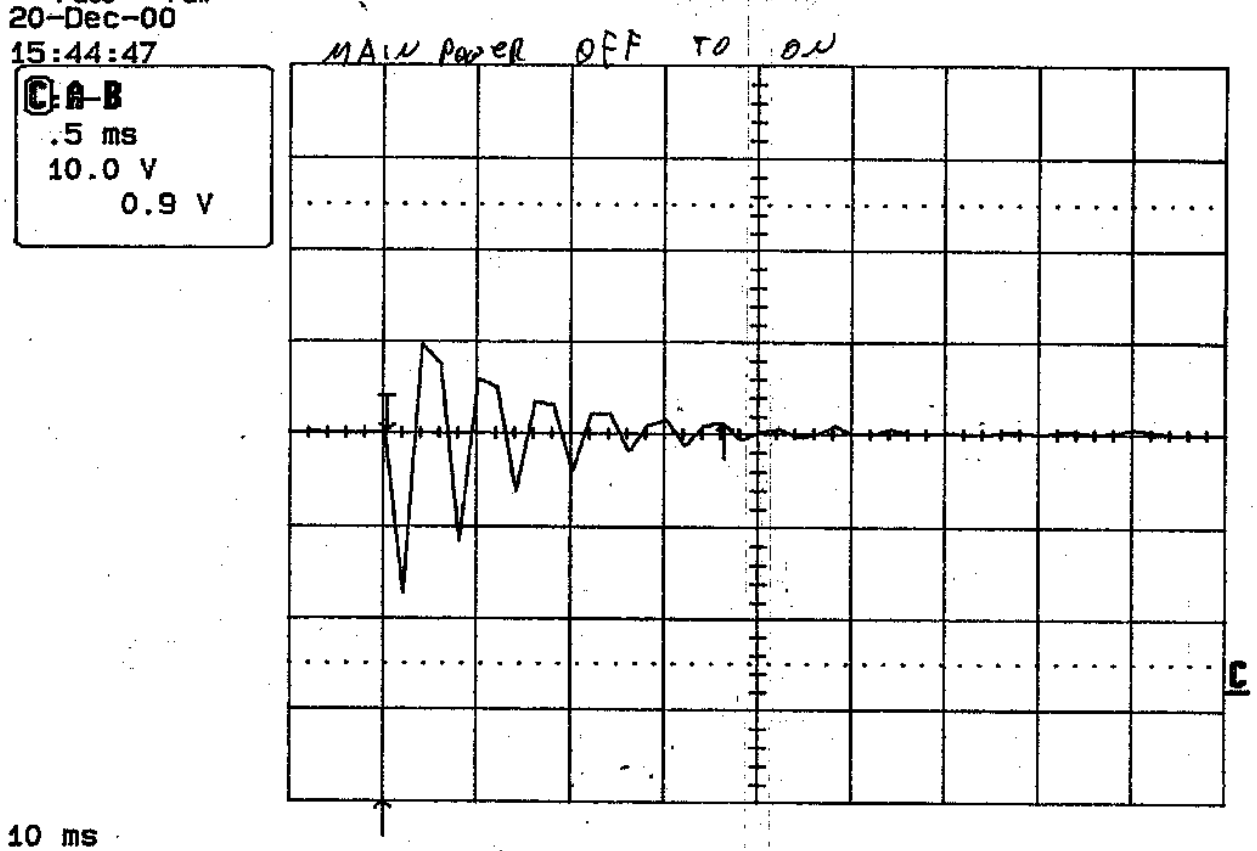
The compressor takes approximately seven minutes to cool the chamber to the desired temperature. The cool down rate is dependant on the rotor speed, and will cool down faster if the rotor is set to higher speeds. After the set temperature has been achieved, the compressor duty cycle is approximately 61%.

Time Domain Transient Test (CE07)
SSP 30237E

☐ Pass ☒ Fail

HRF Refrigerator Centrifuge
EMI Evaluation
TPS#: 7E0020084

Space Station
LISN S/N_____

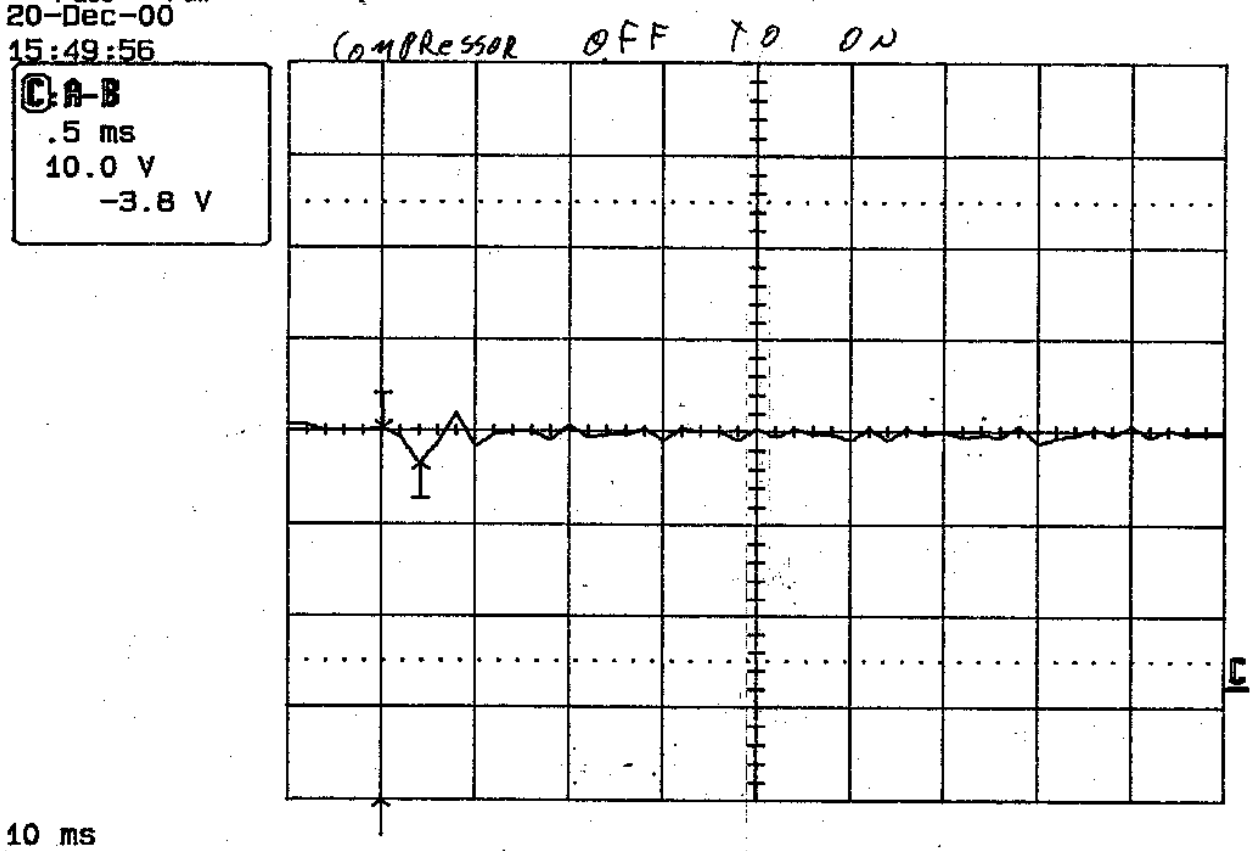


Time Domain Transient Test (CE07)
SSP 30237E

HRF Refrigerator Centrifuge
EMI Evaluation
TPS#: 7E0020084

Space Station
LISN S/N_____

☒ Pass ☐ Fail



Time Domain Transient Test (CE07)
SSP 30237E

☐ Pass ☐ Fail

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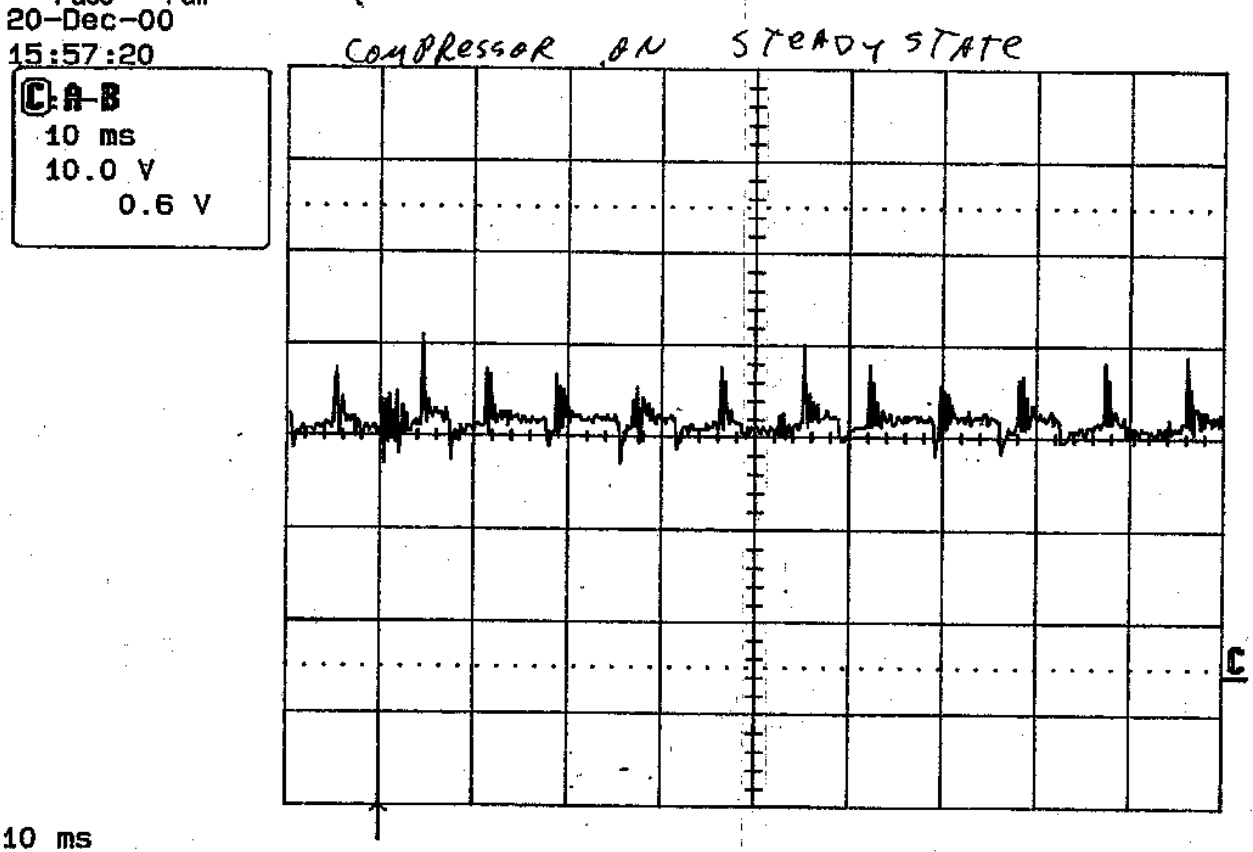
15:57:20

HRF Refrigerator Centrifuge
EMI Evaluation
TPS#: 7E0020084

Space Station
LISN S/N_____



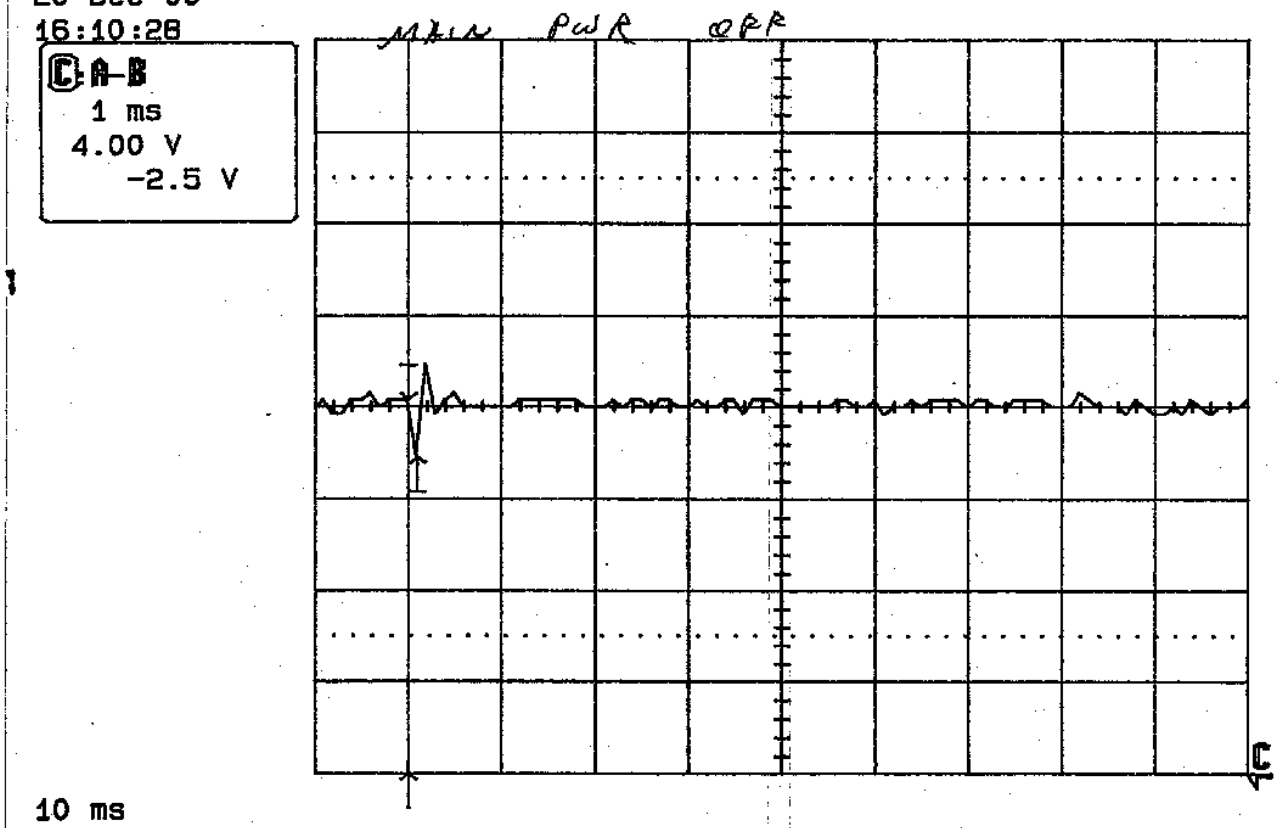
Time Domain Transient Test (CE07)
SSP 30237E

Pass ☐ Fail

20-Dec-00
16:10:28

HRF Refrigerator Centrifuge
EMI Evaluation
TPS#: 7E0020084

Space Station
LISN S/N_____



Time Domain Transient Test (CE07)
SSP 30237E
☐ Pass ☐ Fail

HRF Refrigerator Centrifuge
EMI Evaluation
TPS#: 7E0020084

Space Station
LISN S/N_____

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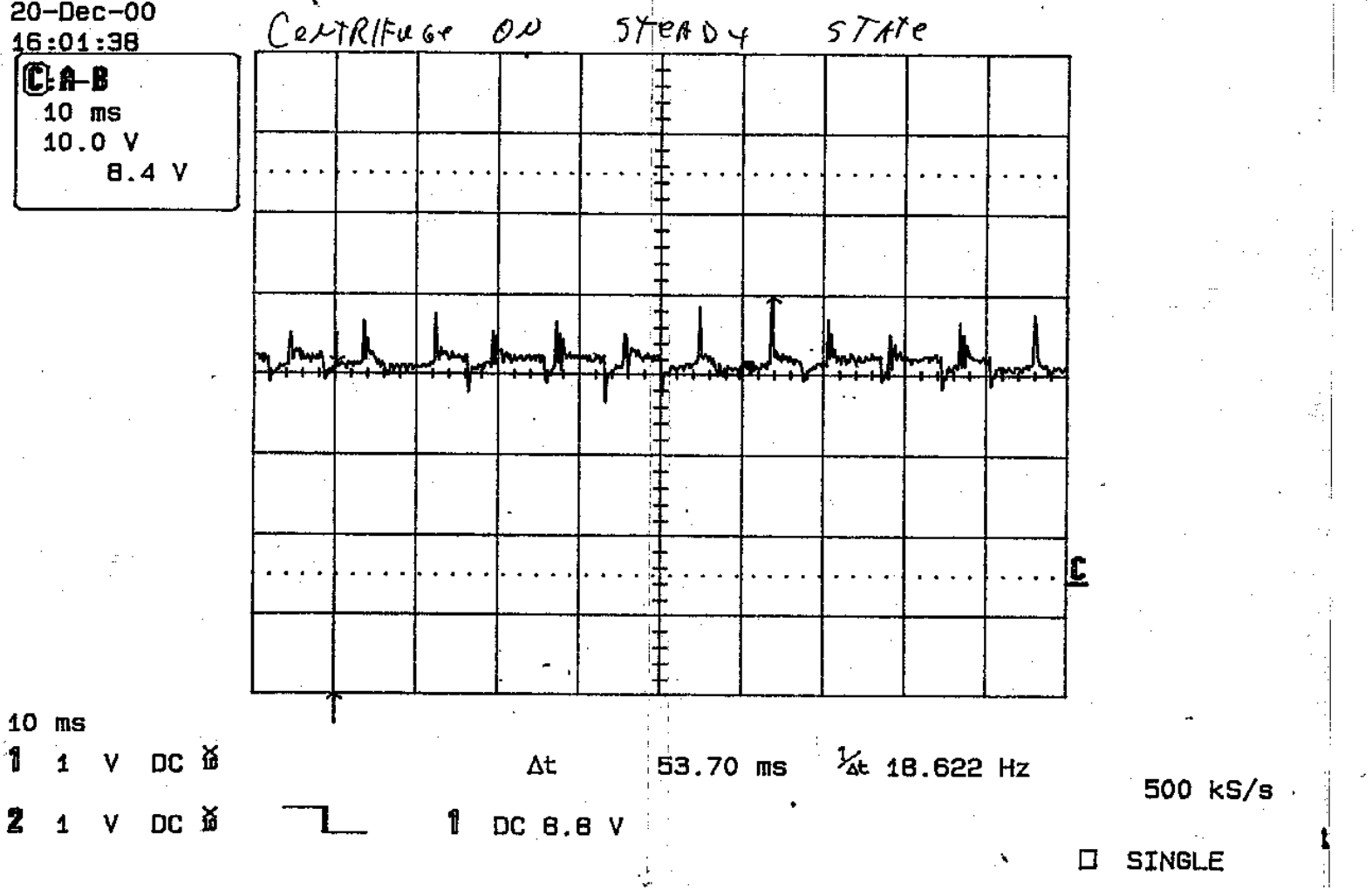

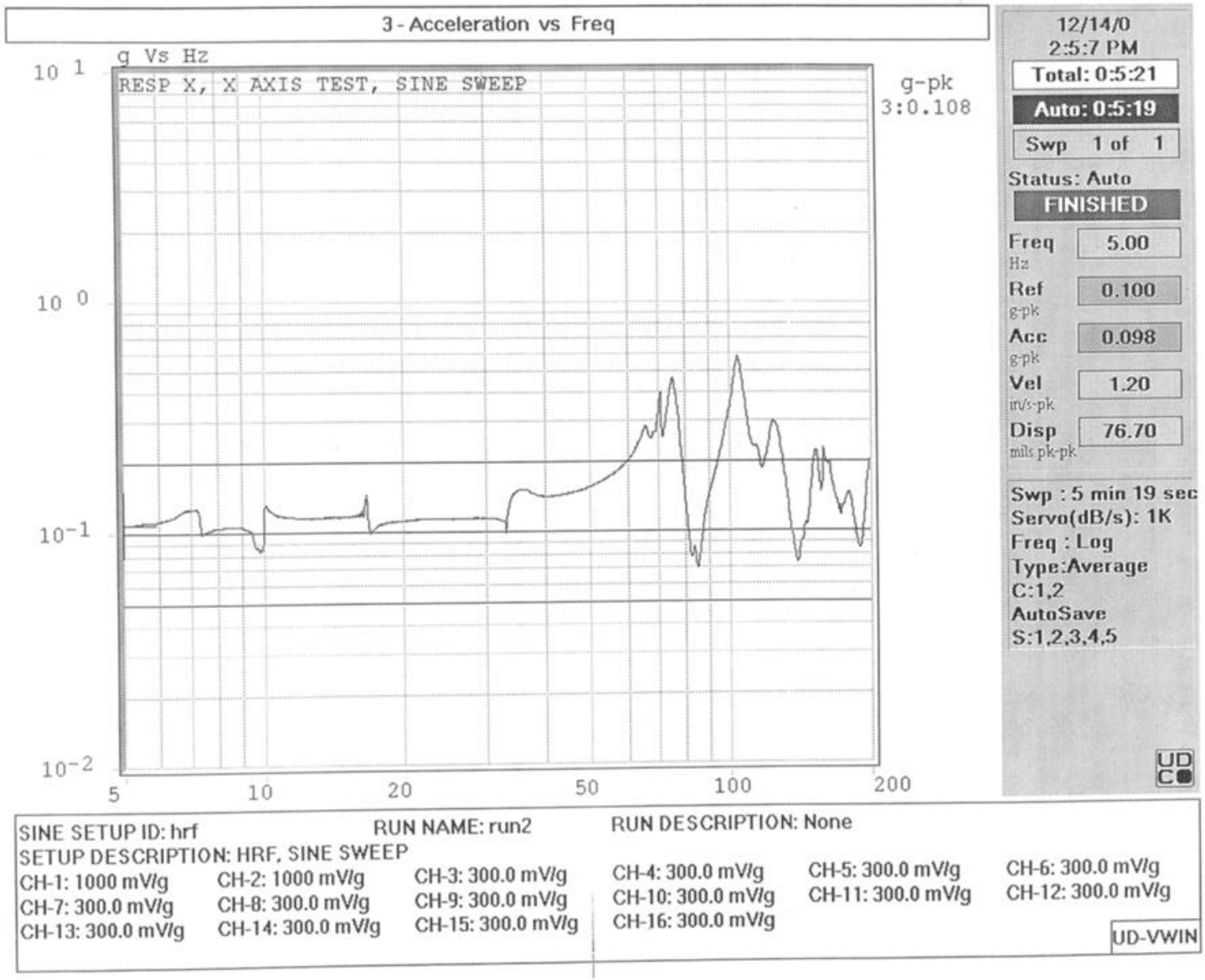
3 - Acceleration vs Freq
g Vs Hz
RESP X, X AXIS TEST, SINE SWEEP
g-pk
3:0.108
10 1
10 0
10-1
10-2
5
10
20
50
100
200
12/14/0
2:5:7 PM
Total: 0:5:21
Auto: 0:5:19
Swp 1 of 1
Status: Auto
FINISHED
Freq 5.00 Hz
Ref 0.100 g-pk
Acc 0.098 g-pk
Vel 1.20 in/s-pk
Disp 76.70 mils pk-pk
Swp : 5 min 19 sec
Servo(dB/s): 1K
Freq : Log
Type:Average
C:1,2
AutoSave
S:1,2,3,4,5
UD C
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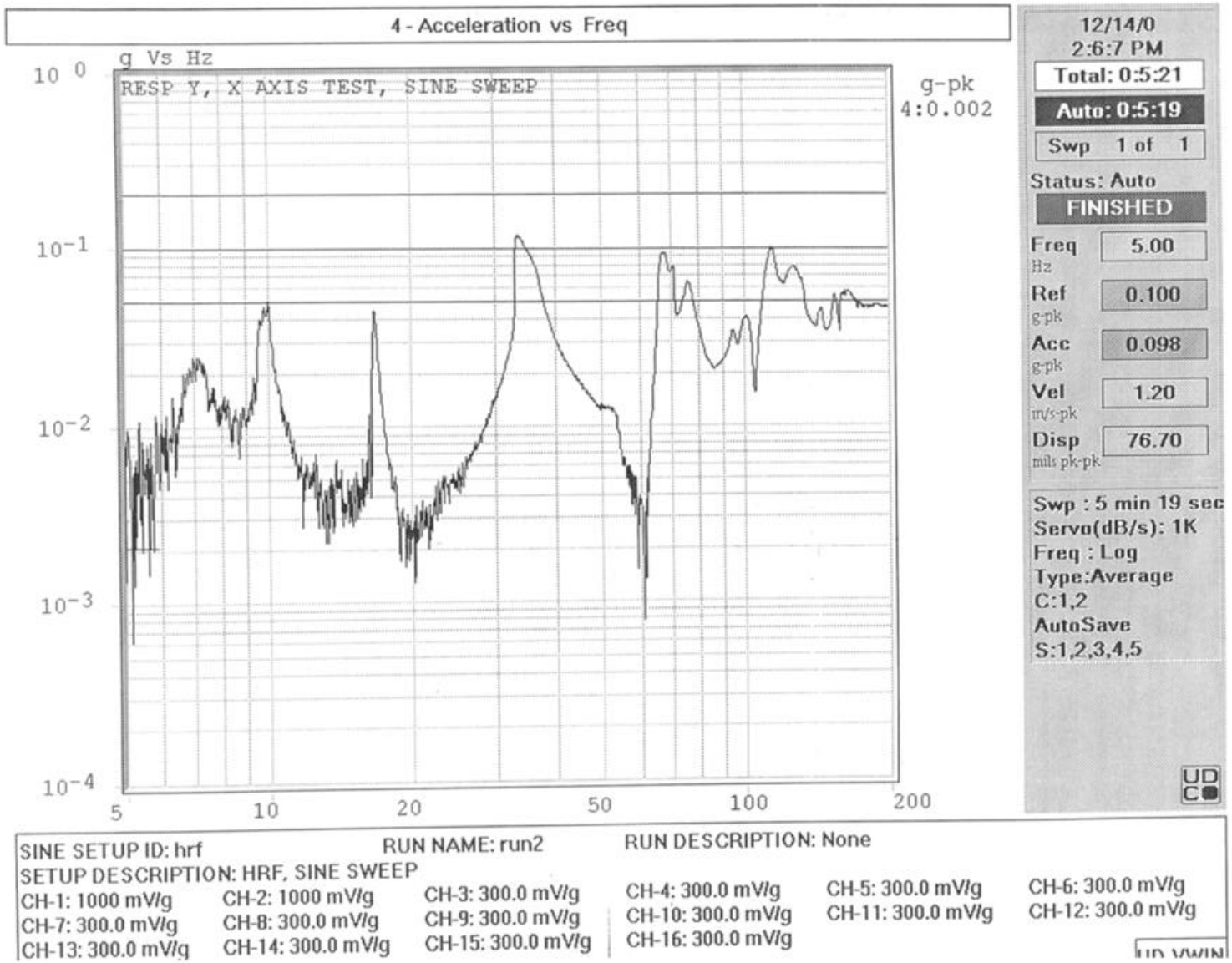
RUN NAME: run2
RUN DESCRIPTION: None
SETUP DESCRIPTION: HRF, SINE SWEEP
CH-1: 1000 mV/g
CH-2: 1000 mV/g
CH-3: 300.0 mV/g
CH-4: 300.0 mV/g
CH-5: 300.0 mV/g
CH-6: 300.0 mV/g
CH-7: 300.0 mV/g
CH-8: 300.0 mV/g
CH-9: 300.0 mV/g
CH-10: 300.0 mV/g
CH-11: 300.0 mV/g
CH-12: 300.0 mV/g
CH-13: 300.0 mV/g
CH-14: 300.0 mV/g
CH-15: 300.0 mV/g
CH-16: 300.0 mV/g
UD-VWIN


4 - Acceleration vs Freq
g Vs Hz
RESP Y, X AXIS TEST, SINE SWEEP
g-pk
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10-1
10-2
10-3
10-4
5
10
20
50
100
200
12/14/0
2:6:7 PM
Total: 0:5:21
Auto: 0:5:19
Swp 1 of 1
Status: Auto
FINISHED
Freq Hz 5.00
Ref g-pk 0.100
Acc g-pk 0.098
Vel m/s-pk 1.20
Disp mils pk-pk 76.70
Swp : 5 min 19 sec
Servo(dB/s): 1K
Freq : Log
Type:Average
C:1,2
AutoSave
S:1,2,3,4,5
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RUN NAME: run2
RUN DESCRIPTION: None
SETUP DESCRIPTION: HRF, SINE SWEEP
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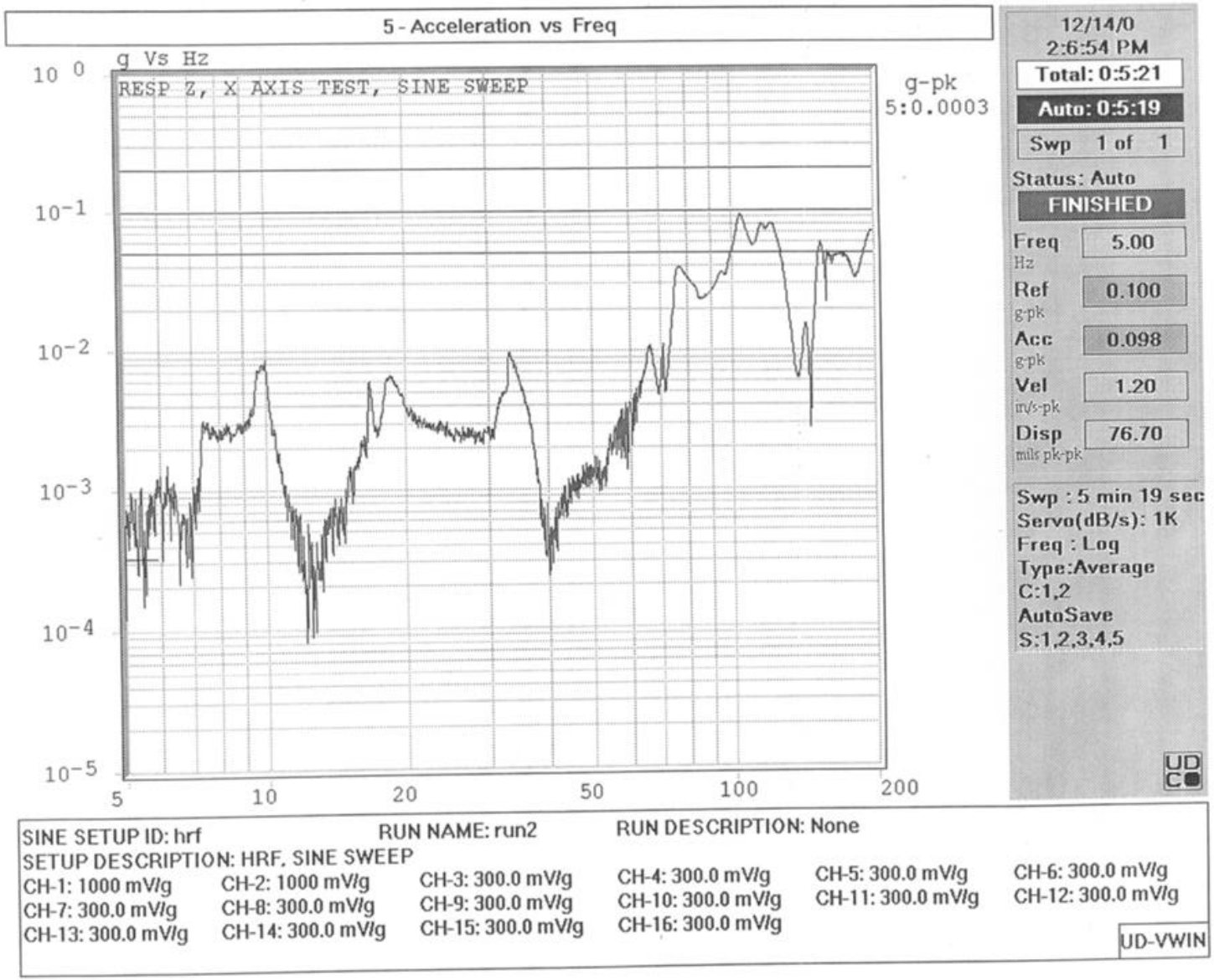
CH-2: 1000 mV/g
CH-3: 300.0 mV/g
CH-4: 300.0 mV/g
CH-5: 300.0 mV/g
CH-6: 300.0 mV/g
CH-7: 300.0 mV/g
CH-8: 300.0 mV/g
CH-9: 300.0 mV/g
CH-10: 300.0 mV/g
CH-11: 300.0 mV/g
CH-12: 300.0 mV/g
CH-13: 300.0 mV/g
CH-14: 300.0 mV/g
CH-15: 300.0 mV/g
CH-16: 300.0 mV/g


5 - Acceleration vs Freq
g Vs Hz
RESP Z, X AXIS TEST, SINE SWEEP
g-pk
5:0.0003
10 0
10-1
10-2
10-3
10-4
10-5
5
10
20
50
100
200
12/14/0
2:6:54 PM
Total: 0:5:21
Auto: 0:5:19
Swp 1 of 1
Status: Auto
FINISHED
Freq 5.00 Hz
Ref 0.100 g-pk
Acc 0.098 g-pk
Vel 1.20 in/s-pk
Disp 76.70 mils pk-pk
Swp : 5 min 19 sec
Servo(dB/s): 1K
Freq : Log
Type:Average
C:1,2
AutoSave
S:1,2,3,4,5
SINE SETUP ID: hrf
RUN NAME: run2
RUN DESCRIPTION: None
SETUP DESCRIPTION: HRF, SINE SWEEP
CH-1: 1000 mV/g
CH-2: 1000 mV/g
CH-3: 300.0 mV/g
CH-4: 300.0 mV/g
CH-5: 300.0 mV/g
CH-6: 300.0 mV/g
CH-7: 300.0 mV/g
CH-8: 300.0 mV/g
CH-9: 300.0 mV/g
CH-10: 300.0 mV/g
CH-11: 300.0 mV/g
CH-12: 300.0 mV/g
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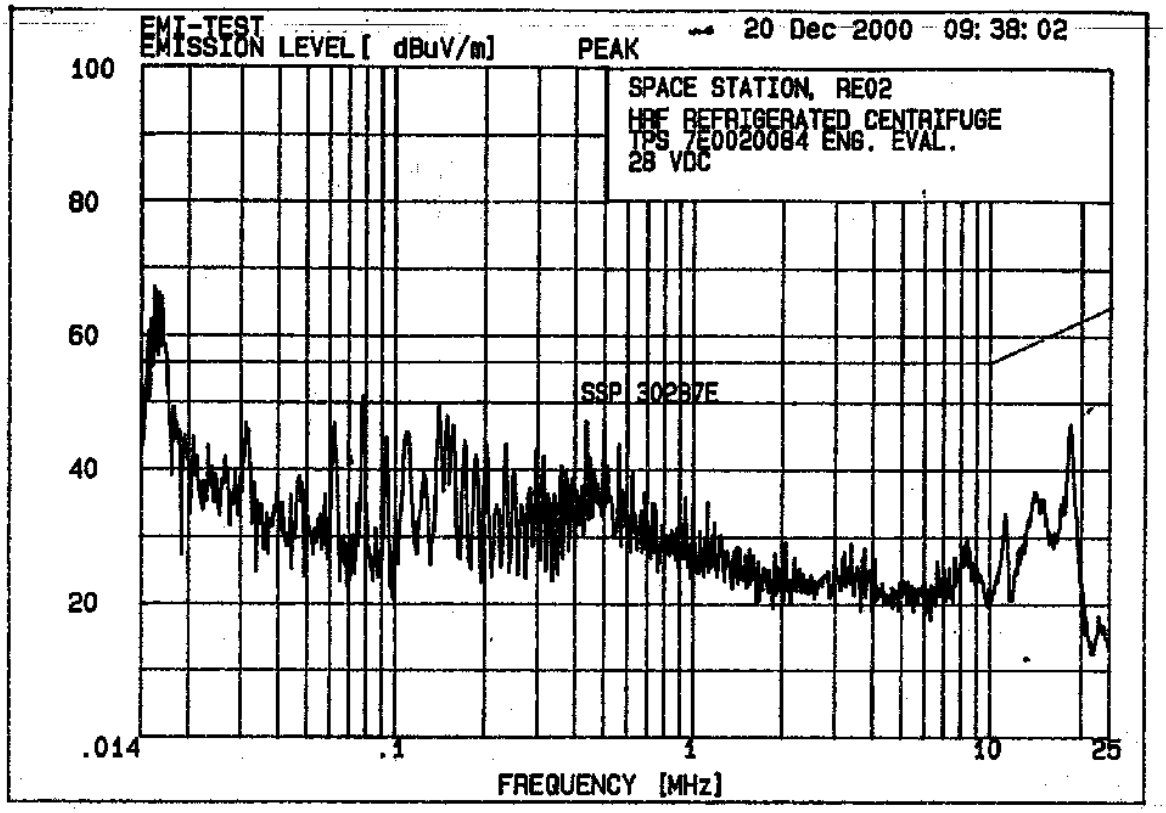
CH-14: 300.0 mV/g
CH-15: 300.0 mV/g
CH-16: 300.0 mV/g
UD-VWIN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20 Dec 2000 09: 38: 02
SPACE STATION, RE02
HRF REFRIGERATED CENTRIFUGE
TPS 7E0020084 ENG. EVAL.
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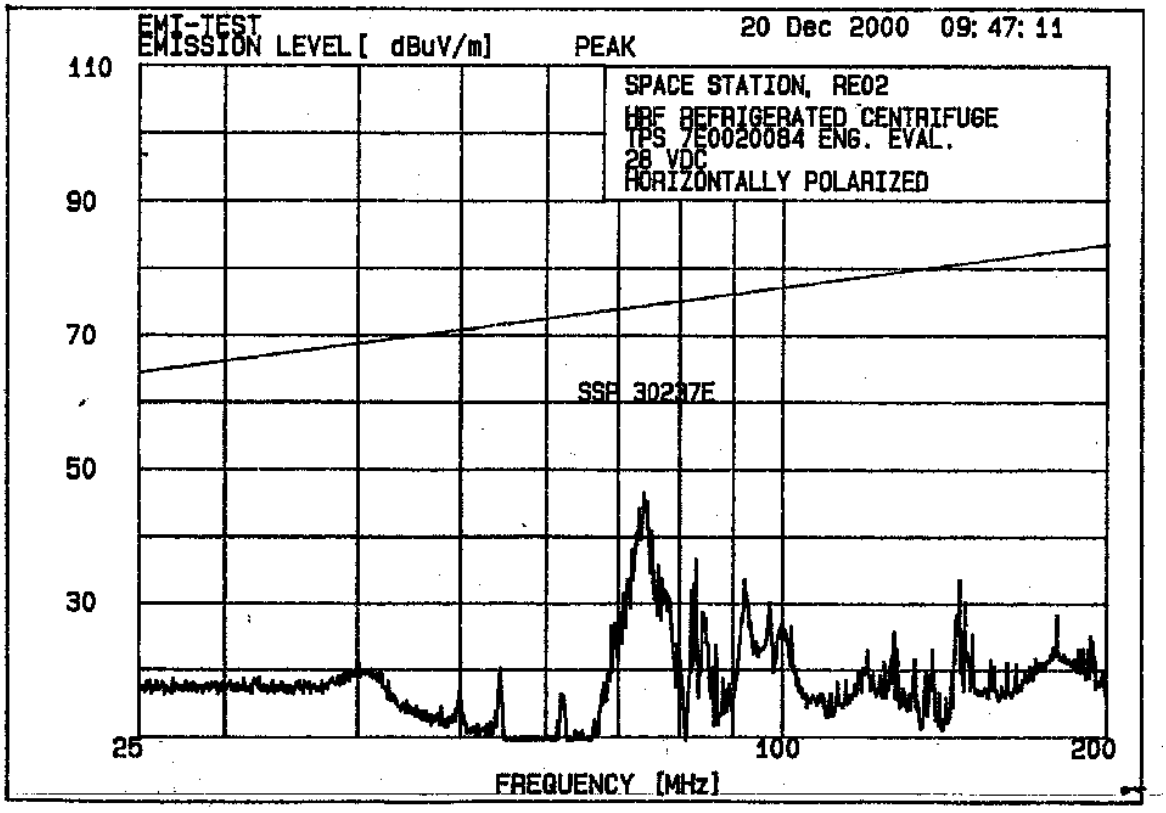
SSP 30237E
100
80
60
40
20
.014
.1
1
10
25
FREQUENCY [MHz]


EMI-TEST
EMISSION LEVEL [dBuV/m]
PEAK
20 Dec 2000 09: 47: 11
SPACE STATION, RE02
HRF REFRIGERATED CENTRIFUGE
TPS 7E0020084 ENG. EVAL.
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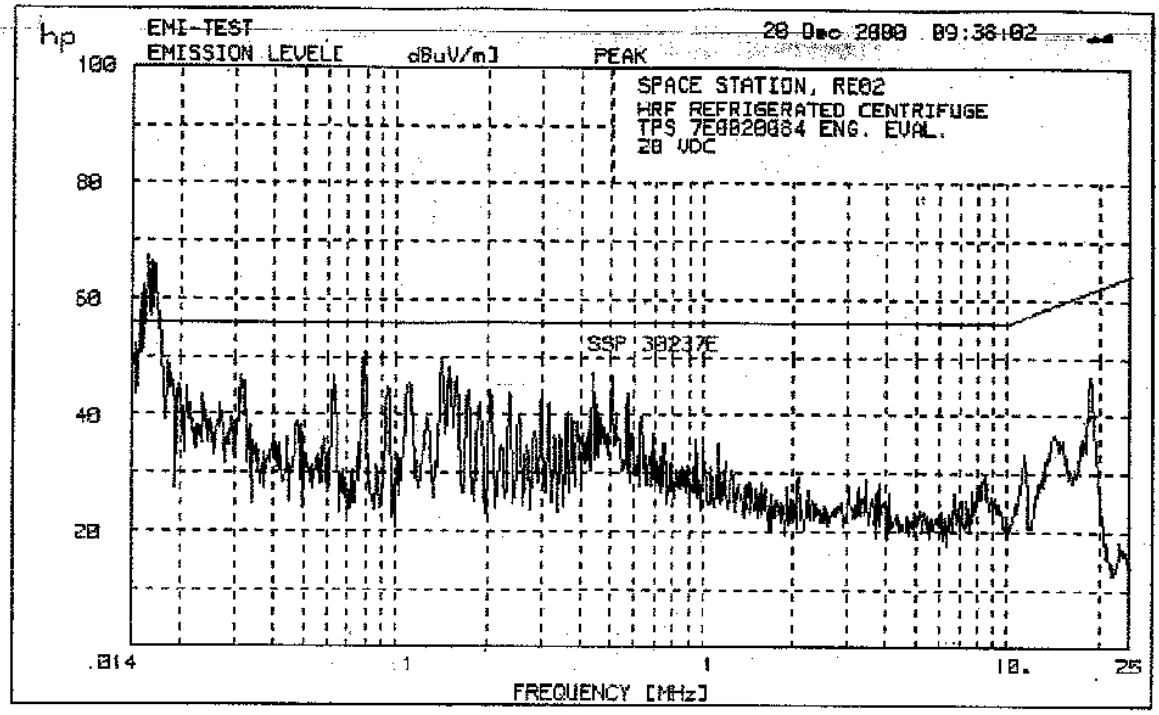
HORIZONTALLY POLARIZED
SSP 30237E
110
90
70
50
30
25
100
200
FREQUENCY [MHz]


hp
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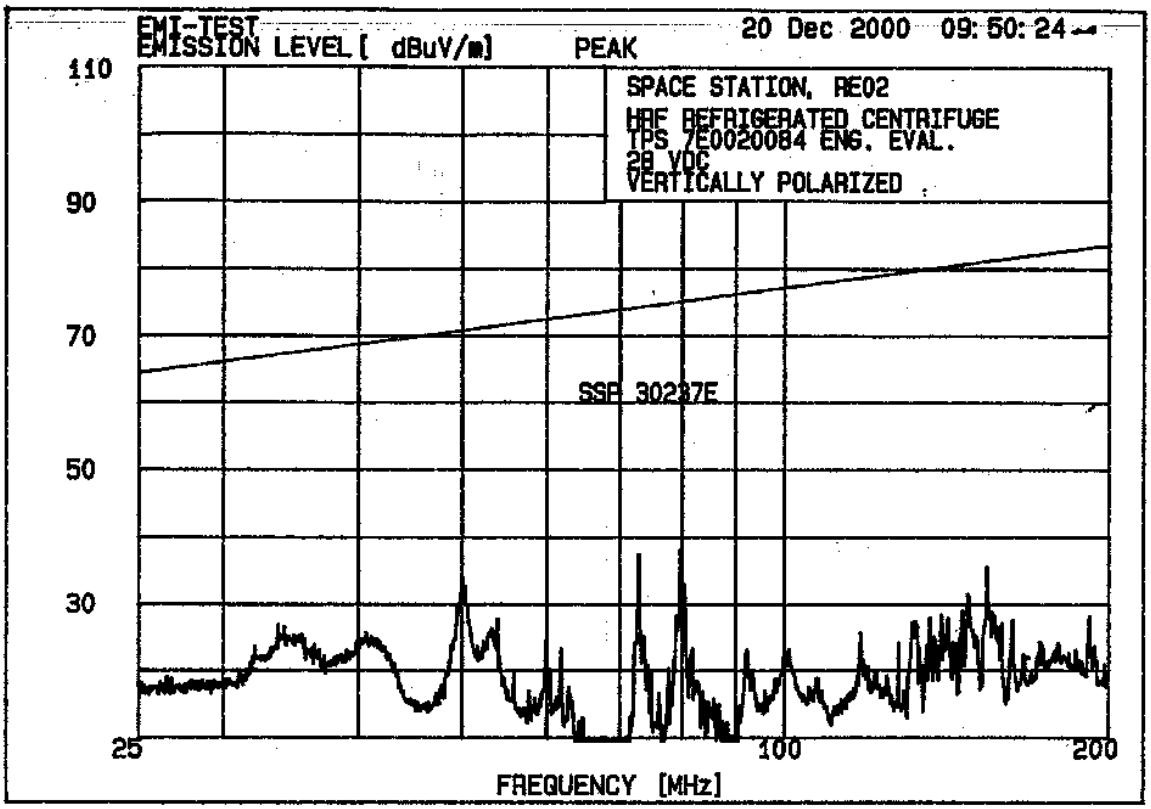
EMISSION LEVELE dBuV/m]
PEAK
20 Dec 2000 09:38:02
SPACE STATION, RE02
HRF REFRIGERATED CENTRIFUGE
TPS 7E0020084 ENG. EVAL.
28 VDC
SSP 30237E
100
80
60
40
20
.014
.1
1
10.
25
FREQUENCY [MHz]

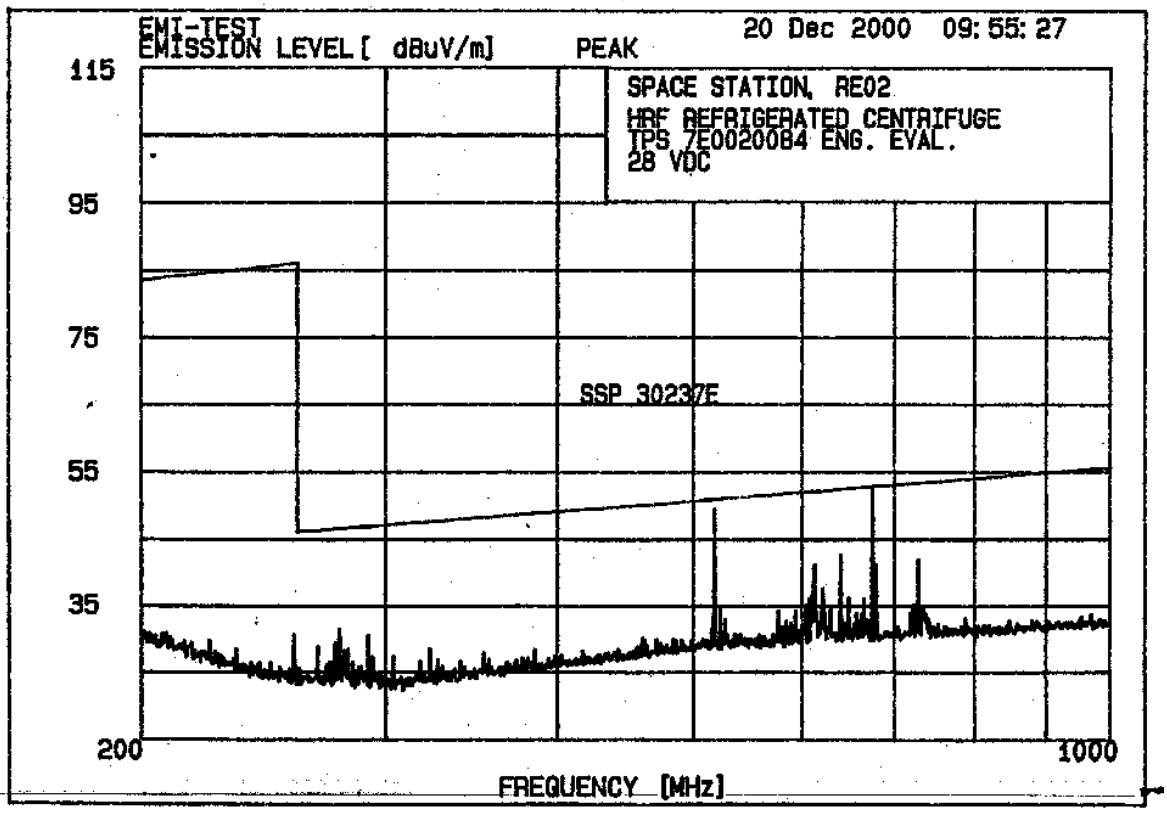
EMI-TEST 20 Dec 2000 09:38:02

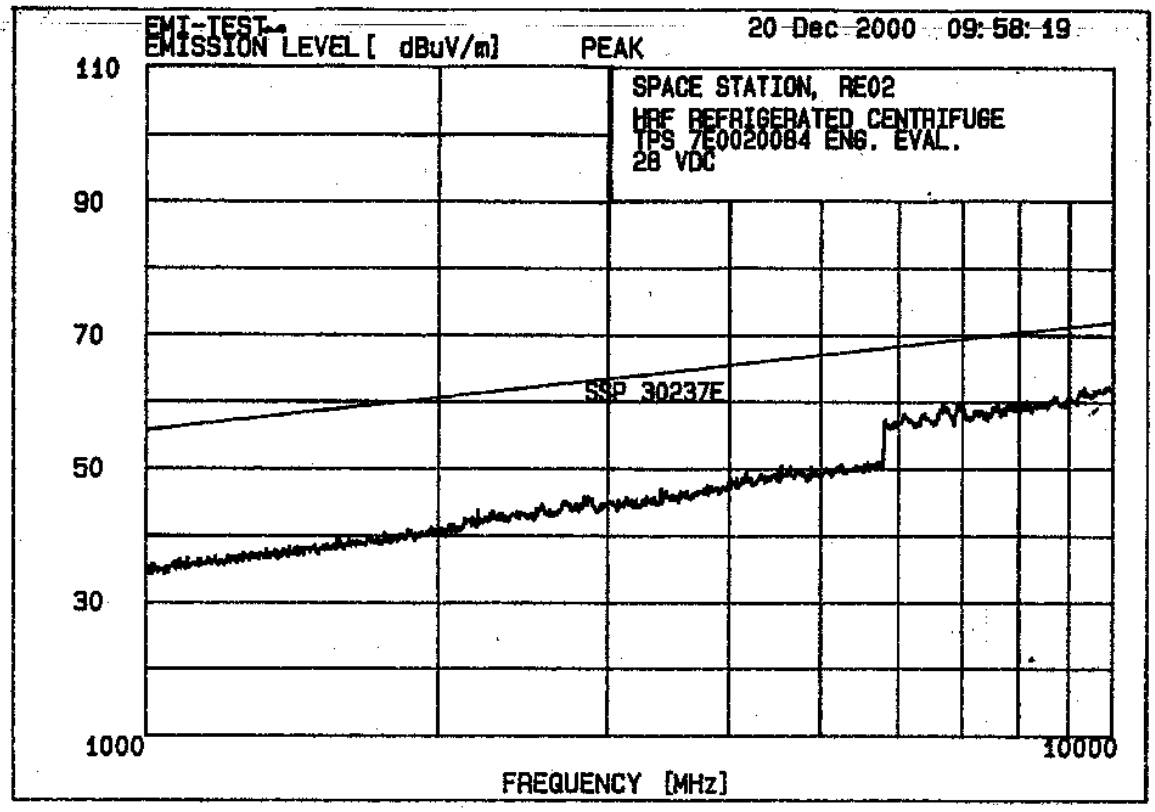
1. SPACE STATION EMISSIONS TESTS
   1.6 RE-02 -- 14KHZ TO 25MHZ

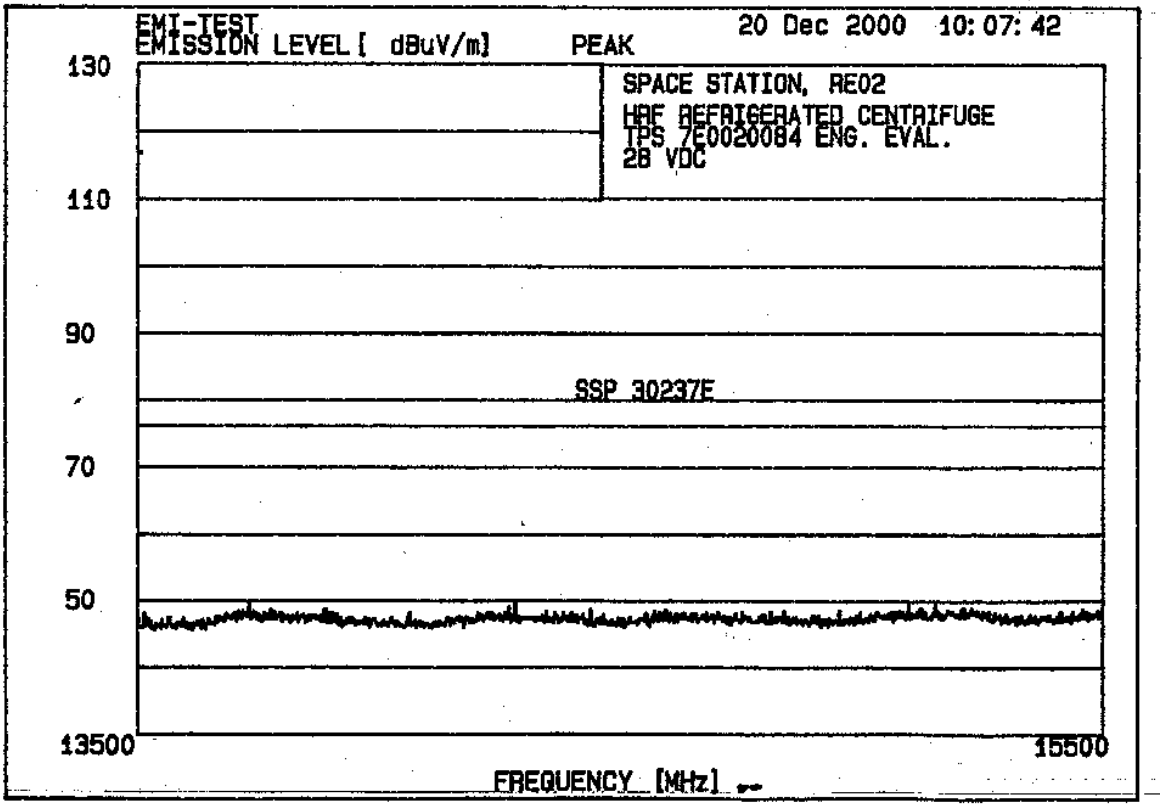
Peaks above 0 dB of Limit Line #1
peak criteria = 3 dB

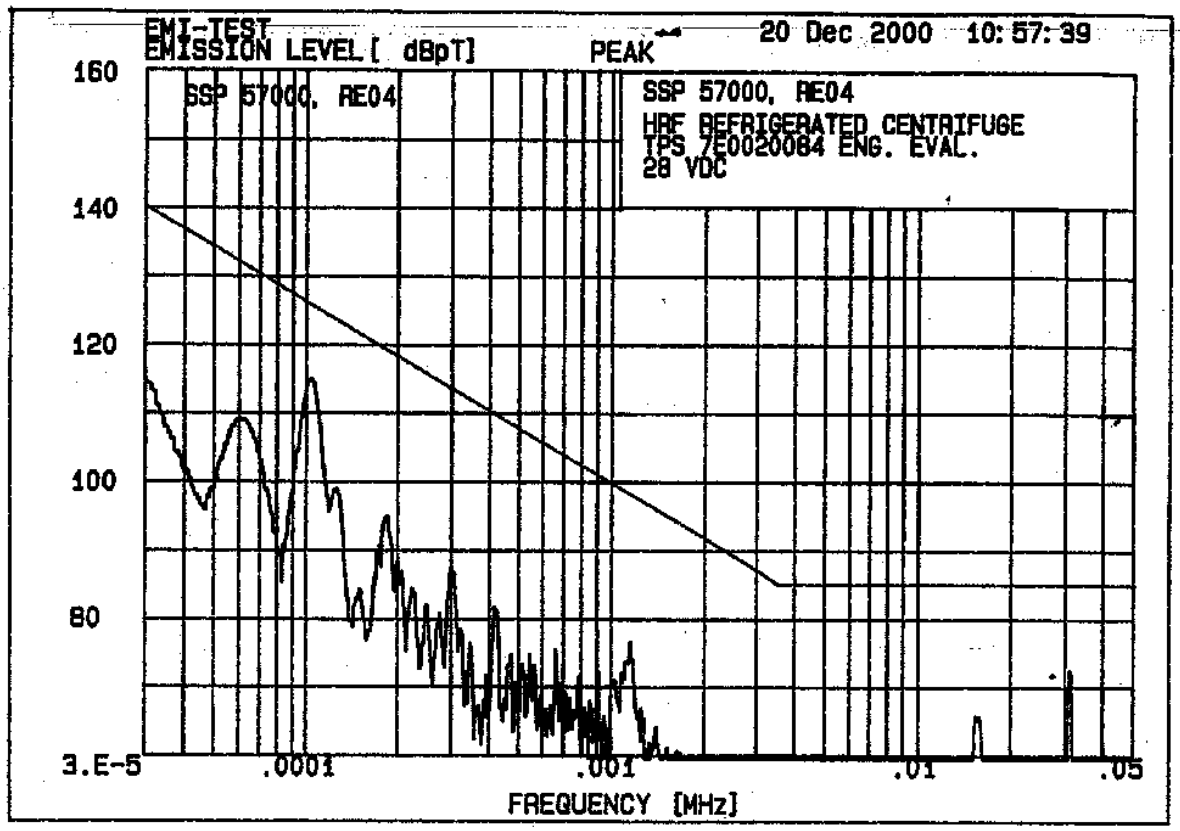
PEAK#	FREQ (MHz)	(dBuV/m)	DELTA
1	.01486	60.7	4.7
2	.0152	62.4	6.4
3	.01555	67.2	11.2
4	.01614	66.3	10.3
5	.0165	65.7	9.7


EMI-TEST
EMISSION LEVEL [dBuV/m]
PEAK
20 Dec 2000 09:50:24
SPACE STATION, RE02
HRF REFRIGERATED CENTRIFUGE
TPS 7E0020084 ENG. EVAL.
28 VDC
VERTICALLY POLARIZED
SSP 30237E
110
90
70
50
30
25
100
200
FREQUENCY [MHz]


EMI-TEST
EMISSION LEVEL [dBuV/m]
PEAK
20 Dec 2000 09:55:27
SPACE STATION, RE02
HRF REFRIGERATED CENTRIFUGE
TPS 7E0020084 ENG. EVAL.
28 VDC
SSP 30237E
115
95
75
55
35
200
1000
FREQUENCY [MHz]


EMI-TEST
EMISSION LEVEL [dBuV/m]
PEAK
20 Dec 2000 09:58:19
SPACE STATION, RE02
HRF REFRIGERATED CENTRIFUGE
TPS 7E0020084 ENG. EVAL.
28 VDC
SSP 30237F
110
90
70
50
30
1000
10000
FREQUENCY [MHz]


EMI-TEST
EMISSION LEVEL [dBuV/m]
PEAK
20 Dec 2000 10:07:42
SPACE STATION, RE02
HRF REFRIGERATED CENTRIFUGE
TPS 7E0020084 ENG. EVAL.
28 VDC
SSP 30237F
130
110
90
70
50
13500
15500
FREQUENCY [MHz]

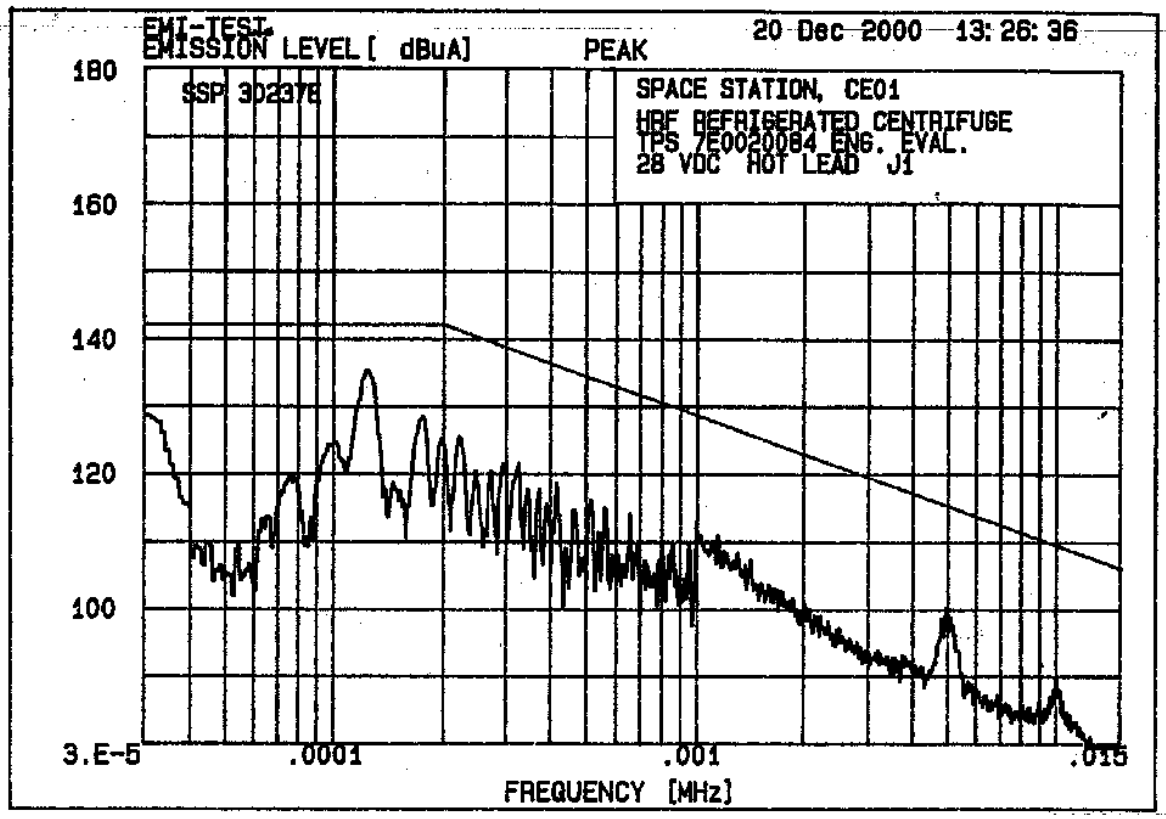

EMI-TEST
20 Dec 2000 10:57:39
EMISSION LEVEL [dBpT]
PEAK
SSP 57000, RE04
SSP 57000, RE04
HRF REFRIGERATED CENTRIFUGE
TPS 7E0020084 ENG. EVAL.
28 VDC
160
140
120
100
80
3.E-5
.0001
.001
.01
.05
FREQUENCY [MHz]

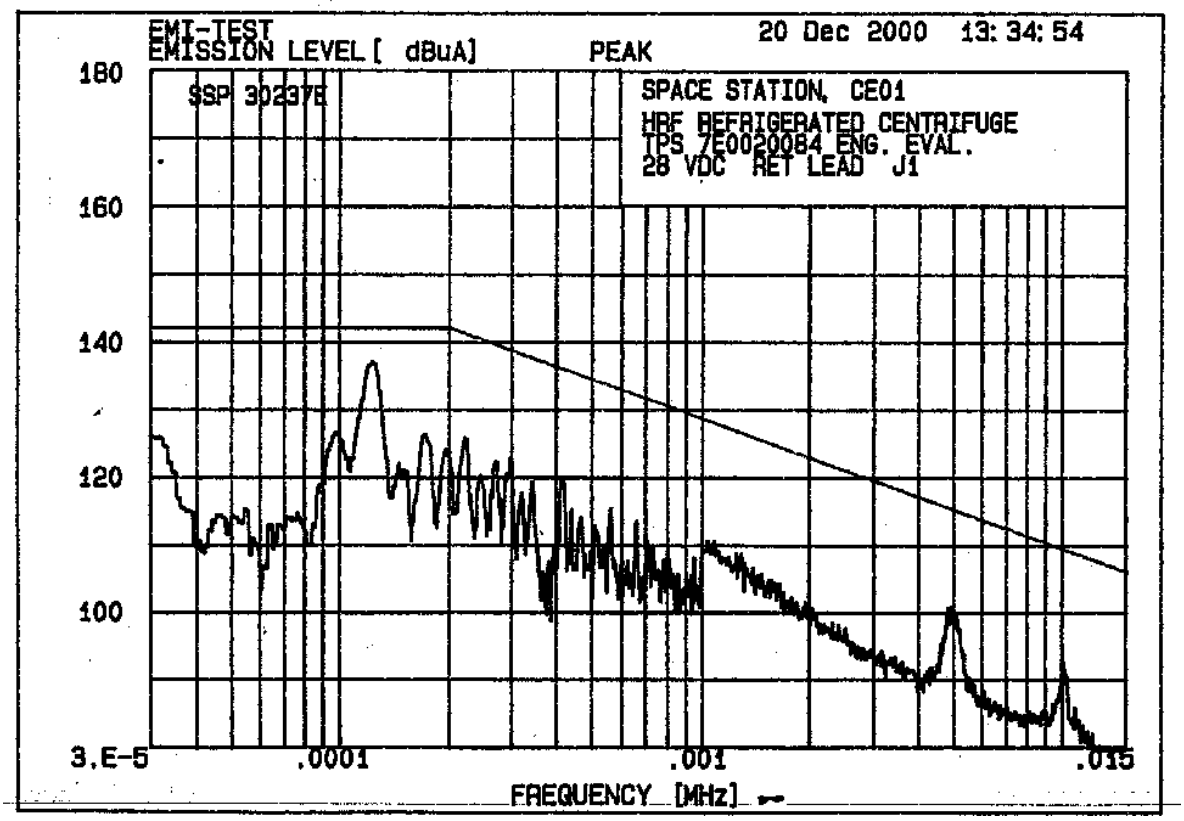
DC Magnetic Field Emission

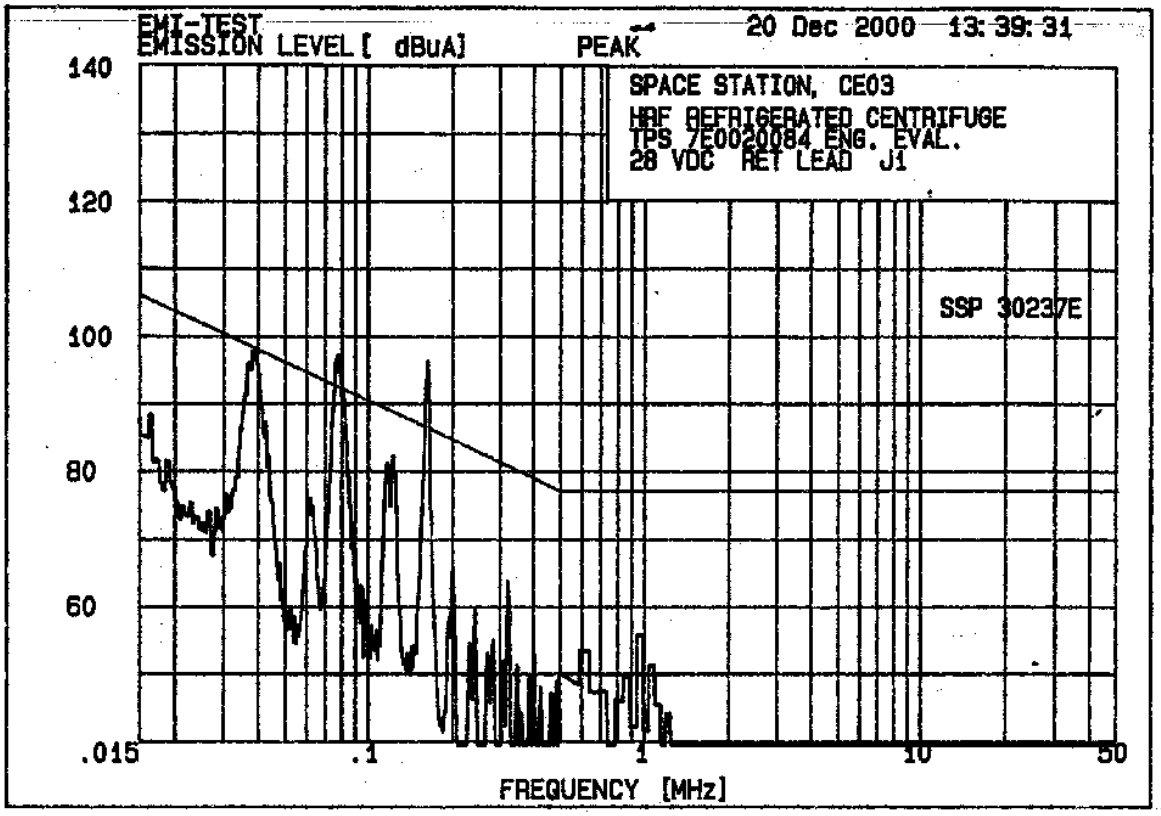
Component	HRF Refrigerator Centrifuge	Document No.	7E0020084
NASA Type No.	SEE TPS	Tested By	J.Wilkins
NASA Serial No.	SEE TPS	Date Tested	12/20/00
Test Run Time	N/A	Quality Status	Evaluation
Type of Test	DC Magnetic Field		
Equipment	F.W. Bell 9500 Gaussmeter		
Distance	7 cm		

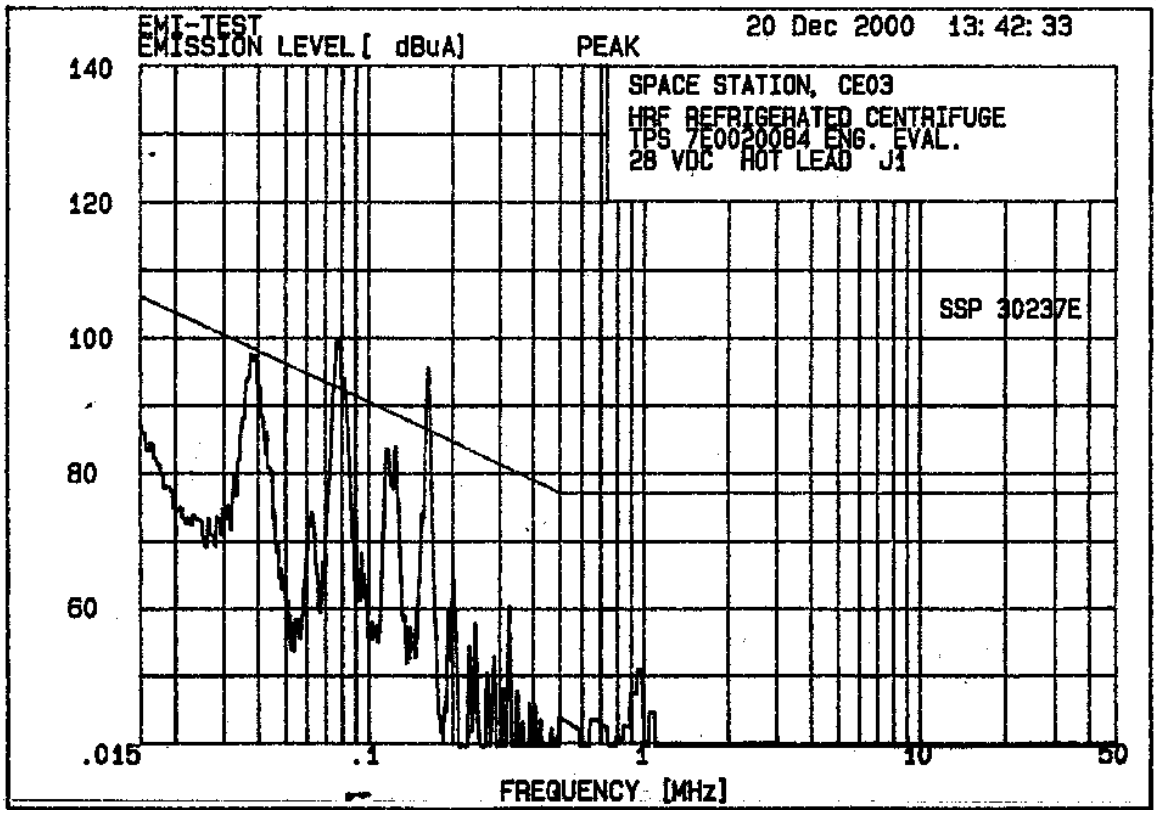
Measurement Results

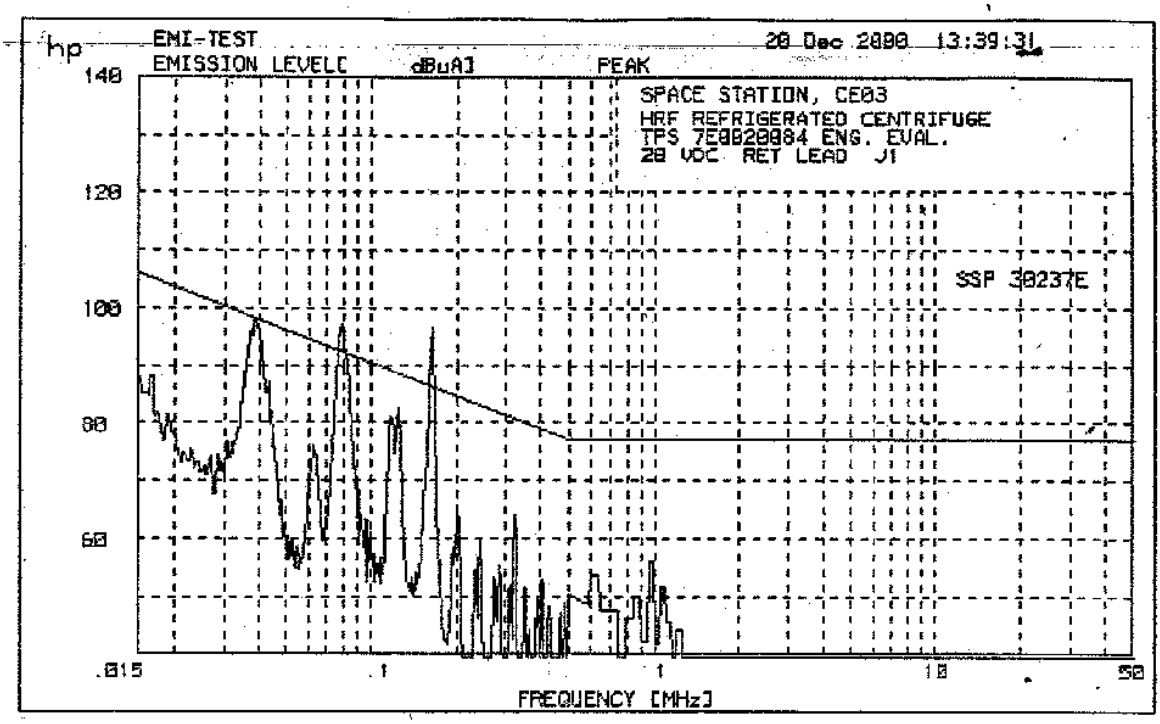
Locations	Maximum Readings (dBpT)	Limits (dBpT)	Test Results
At lower right corner of centrifuge door	146.02 dBpT (0.2 Gauss)	170	Pass


EMI-TEST
EMISSION LEVEL [dBuA]
PEAK
20 Dec 2000 13:26:36
SSP 30237E
SPACE STATION, CE01
HRF REFRIGERATED CENTRIFUGE
TPS 7E0020084 ENG. EVAL.
28 VDC HOT LEAD J1
180
160
140
120
100
3.E-5
.0001
.001
.015
FREQUENCY [MHz]


EMI-TEST
EMISSION LEVEL [dBuA]
PEAK
20 Dec 2000 13:34:54
SSP 30237E
SPACE STATION, CE01
HRF REFRIGERATED CENTRIFUGE
TPS 7E0020084 ENG. EVAL.
28 VDC RET LEAD J1
180
160
140
120
100
3.E-5
.0001
.001
.015
FREQUENCY [MHz]


EMI-TEST
EMISSION LEVEL [dBuA]
PEAK
20 Dec 2000 13:39:31
SPACE STATION, CE03
HRF REFRIGERATED CENTRIFUGE
TPS 7E0020084 ENG. EVAL.
28 VDC RET LEAD J1
SSP 30237E
140
120
100
80
60
.015
.1
1
10
50
FREQUENCY [MHz]


EMI-TEST
EMISSION LEVEL [dBuA]
PEAK
20 Dec 2000 13:42:33
SPACE STATION, CE03
HRF REFRIGERATED CENTRIFUGE
TPS 7E0020084 ENG. EVAL.
28 VDC HOT LEAD J1
SSP 30237E
140
120
100
80
60
.015
.1
1
10
50
FREQUENCY [MHz]

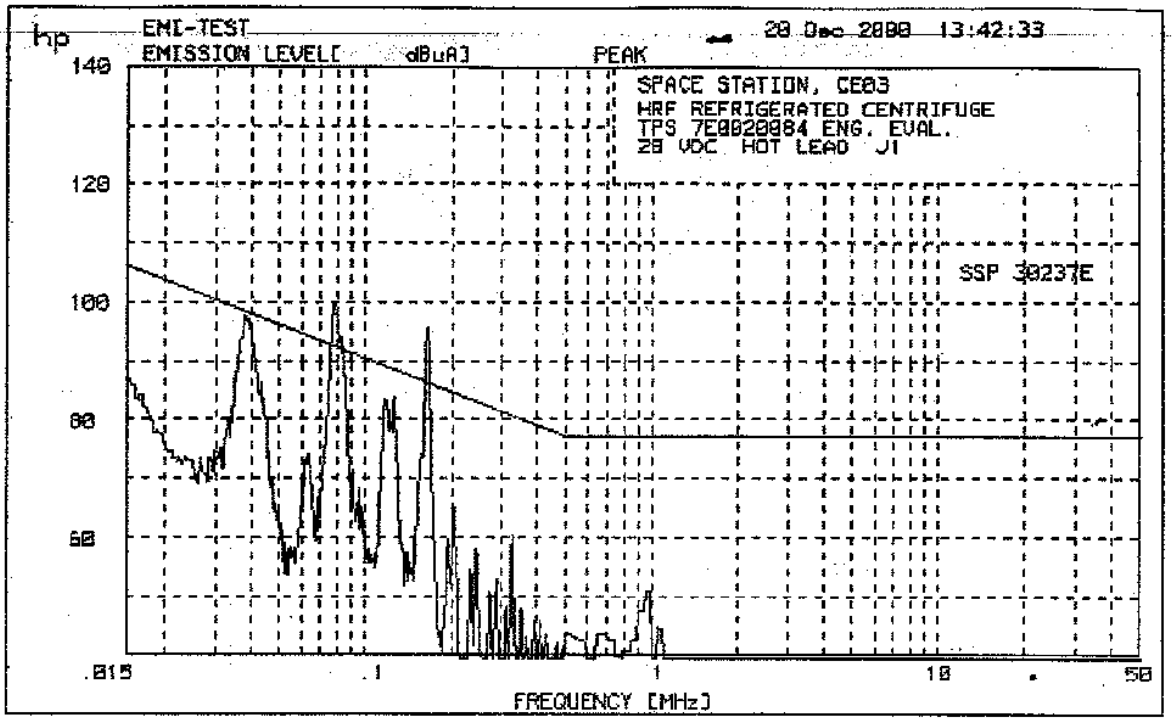

hp
EMI-TEST
20 Dec 2000 13:39:31
EMISSION LEVELC dBuA]
PEAK
SPACE STATION, CE03
HRF REFRIGERATED CENTRIFUGE
TPS 7E0020084 ENG. EVAL.
28 VDC RET LEAD J1
SSP 30237E
140
120
100
80
60
.015
.1
1
10
30
FREQUENCY [MHz]

EMI-TEST 20 Dec 2000 13:39:31

1. SPACE STATION EMISSIONS TESTS
   1.3 CE-03 -- 15KHZ TO 50MHZ

Peaks above 0 dB of Limit Line #1
peak criteria = 3 dB

PEAK#	FREQ (MHz)	(dBuA)	DELTA
1	.07835	97.3	5.0
2	.1638	96.4	10.2

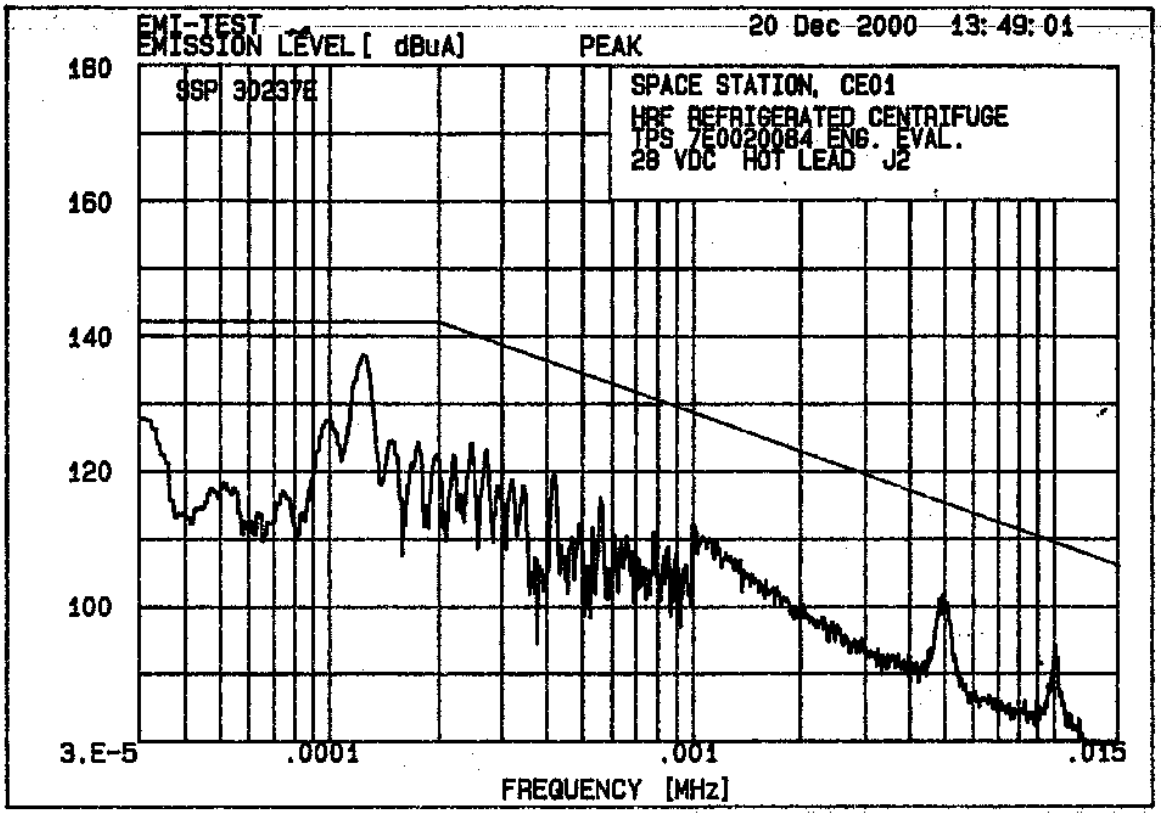

hp
EMI-TEST
20 Dec 2000 13:42:33
EMISSION LEVEL[dBuA]
PEAK
SPACE STATION, CE03
HRF REFRIGERATED CENTRIFUGE
TPS 7E0020084 ENG. EVAL.
28 VDC HOT LEAD J1
SSP 30237E
140
120
100
80
60
.015
.1
1
10
50
FREQUENCY [MHz]

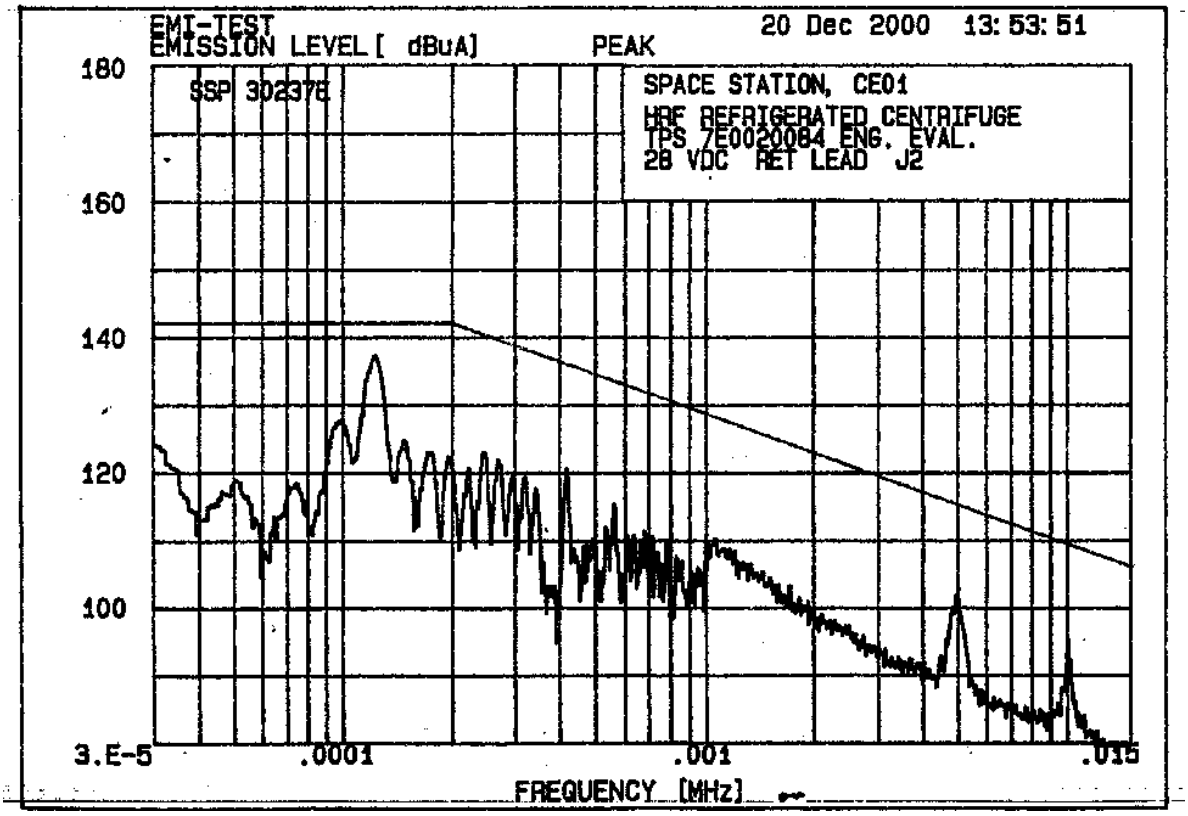
EMI-TEST 20 Dec 2000 13:42:33

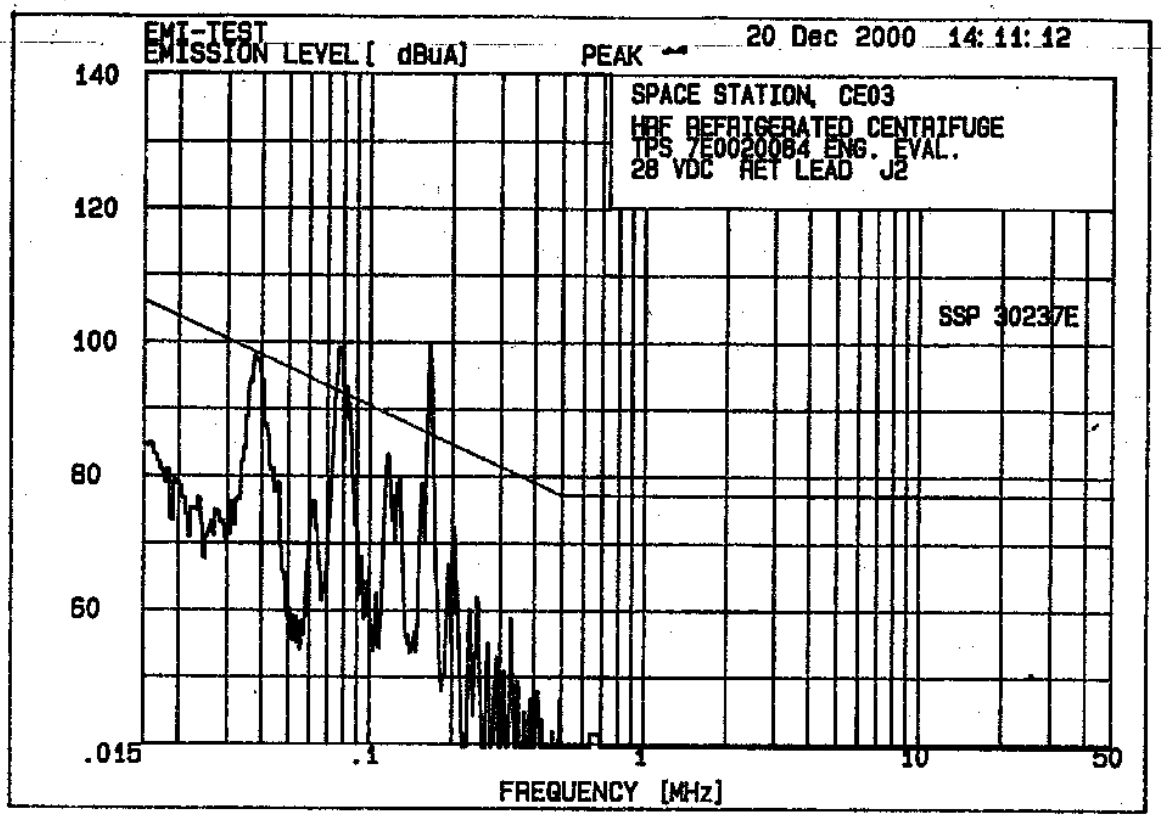
1. SPACE STATION EMISSIONS TESTS
   1.3 CE-03 -- 15KHZ TO 50MHZ

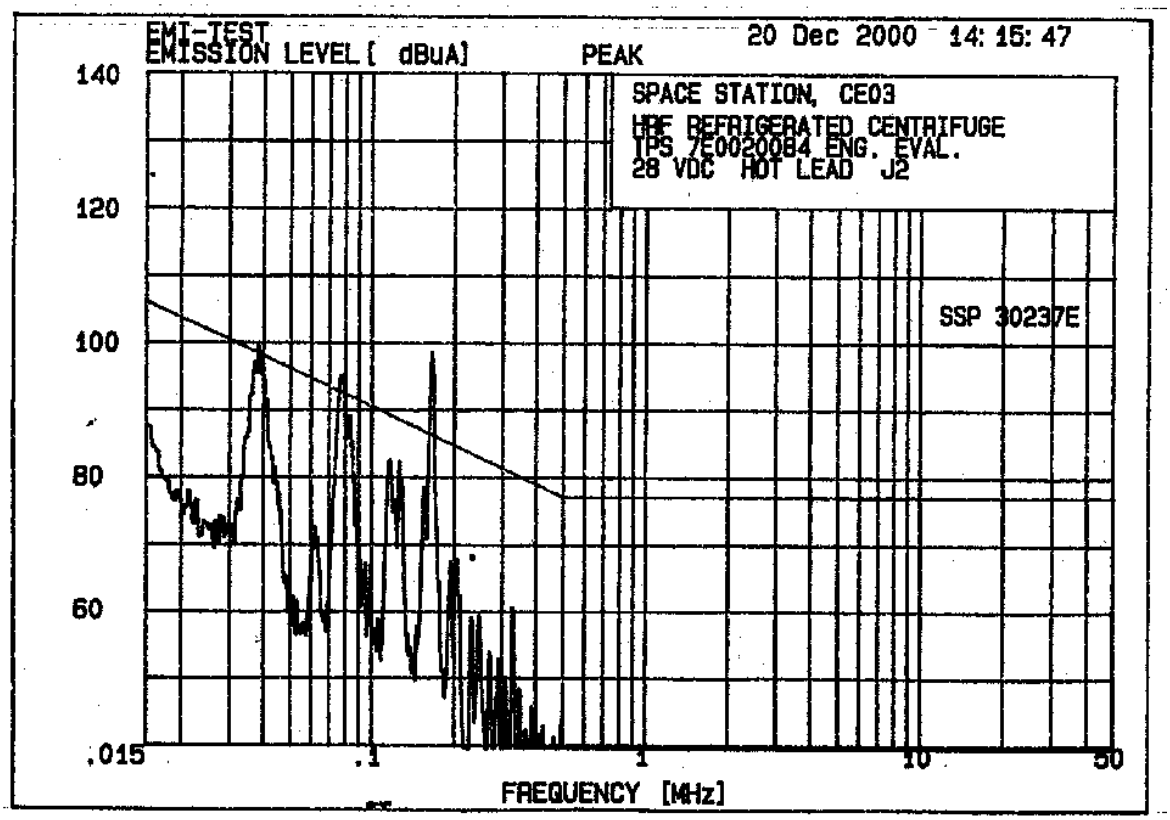
Peaks above 0 dB of Limit Line #1
peak criteria = 3 dB

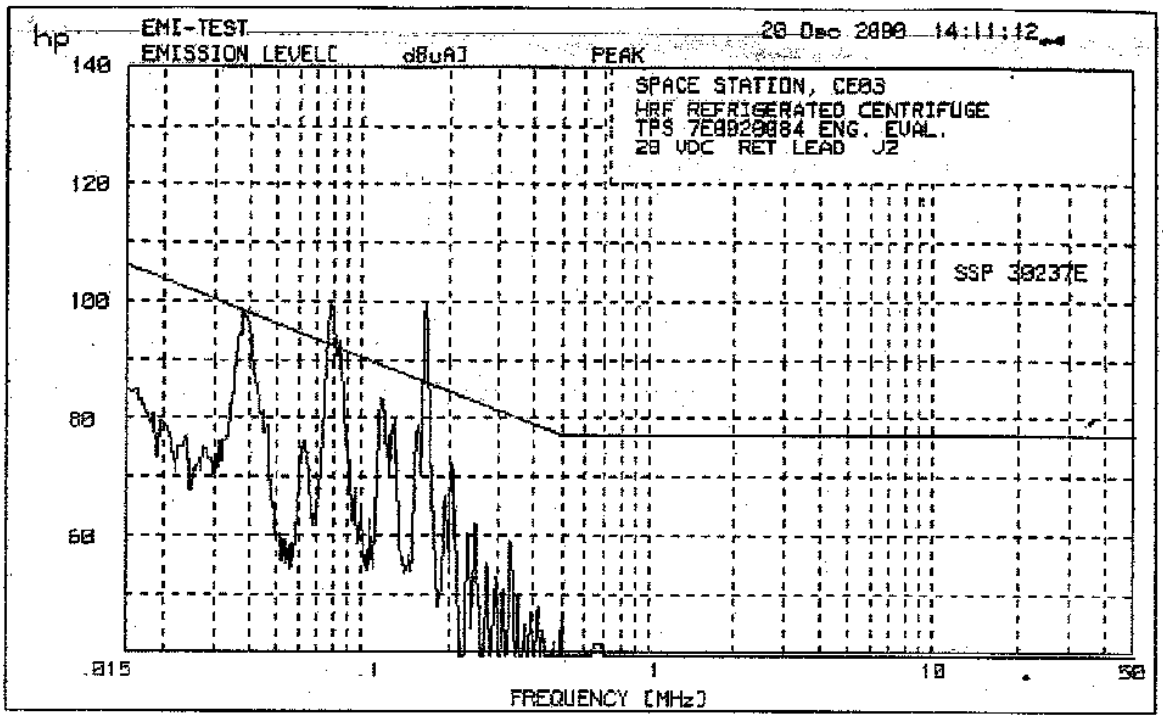
PEAK#	FREQ (MHz)	(dBuA)	DELTA
1	.07772	99.6	7.3
2	.1638	95.6	9.4


EMI-TEST
20 Dec 2000 13:49:01
EMISSION LEVEL [dBuA]
PEAK
SSP 30237E
SPACE STATION, CE01
HRF REFRIGERATED CENTRIFUGE
TPS 7E0020084 ENG. EVAL.
28 VDC HOT LEAD J2
180
160
140
120
100
3.E-5
.0001
.001
.015
FREQUENCY [MHz]


EMI-TEST
20 Dec 2000 13:53:51
EMISSION LEVEL [dBuA]
PEAK
SSP 30237E
SPACE STATION, CE01
HRF REFRIGERATED CENTRIFUGE
TPS 7E0020084 ENG. EVAL.
28 VDC RET LEAD J2
180
160
140
120
100
3.E-5
.0001
.001
.015
FREQUENCY [MHz]


EMI-TEST
EMISSION LEVEL [dBuA]
PEAK
20 Dec 2000 14:11:12
SPACE STATION, CE03
HRF REFRIGERATED CENTRIFUGE
IPS 7E0020084 ENG. EVAL.
28 VDC RET LEAD J2
SSP 30237E
140
120
100
80
60
.015
.1
1
10
50
FREQUENCY [MHz]


EMI-TEST
EMISSION LEVEL [dBuA]
PEAK
20 Dec 2000 14:15:47
SPACE STATION, CE03
HRF REFRIGERATED CENTRIFUGE
IPS 7E0020084 ENG. EVAL.
28 VDC HOT LEAD J2
SSP 30237E
140
120
100
80
60
.015
.1
1
10
50
FREQUENCY [MHz]

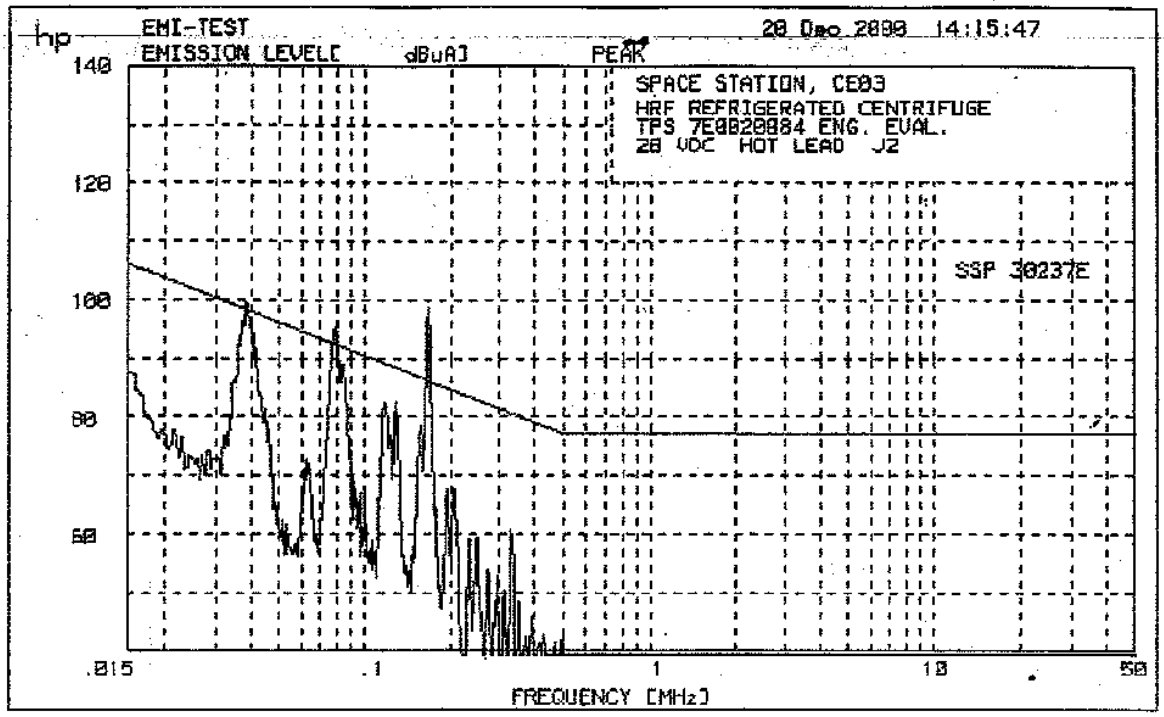

hp
EMI-TEST
28 Dec 2000 14:11:12
EMISSION LEVELC dBuA] PEAK
SPACE STATION, CE03
HRF REFRIGERATED CENTRIFUGE
TPS 7E0020084 ENG. EVAL.
28 VDC RET LEAD J2
SSP 30237E
140
120
100
80
60
.015
.1
1
10
30
FREQUENCY [MHz]

EMI-TEST 20 Dec 2000 14:11:12

1. SPACE STATION EMISSIONS TESTS
   1.9 SPACE STATION, CE03

Peaks above 0 dB of Limit Line #1
peak criteria = 3 dB

PEAK#	FREQ (MHz)	(dBuA)	DELTA
1	.07835	99.2	6.9
2	.1665	99.9	13.9

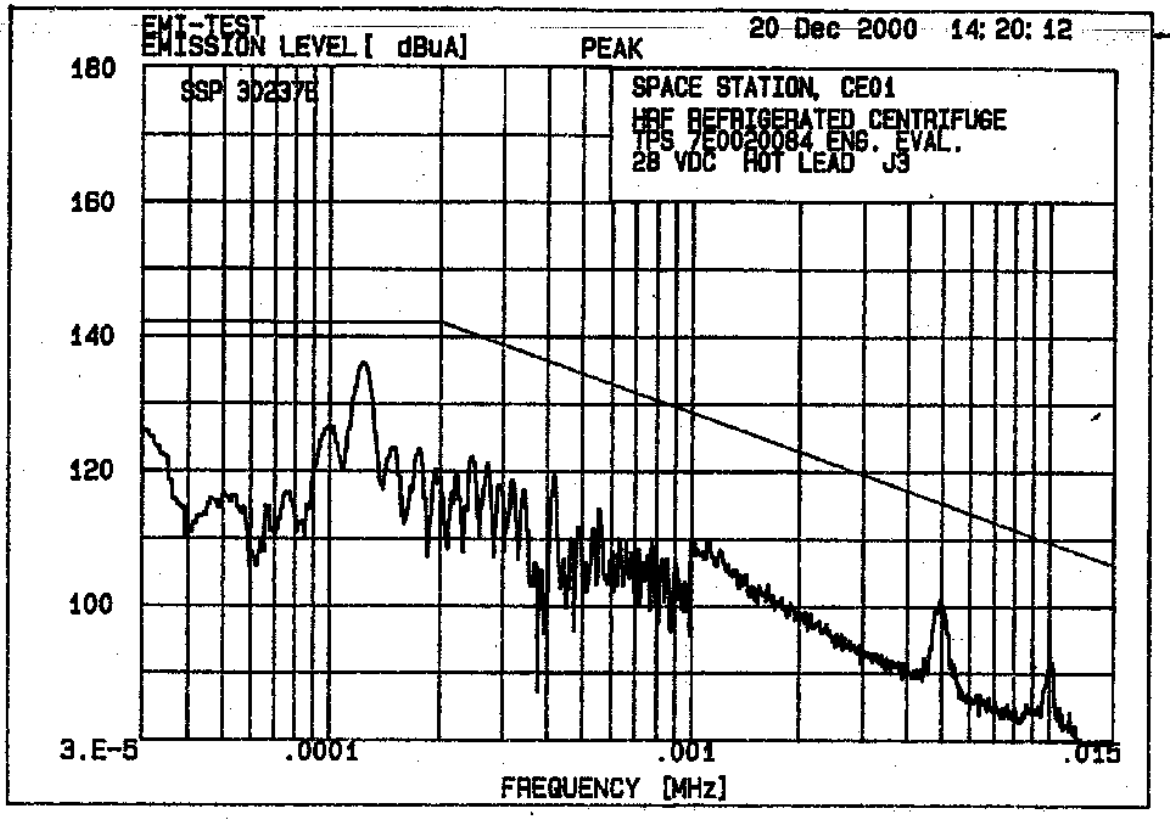

hp
EMI-TEST
20 Dec 2000 14:15:47
EMISSION LEVELS dBuA] PEAK
SPACE STATION, CE03
HRF REFRIGERATED CENTRIFUGE
TPS 7E0020004 ENG. EVAL.
28 VDC HOT LEAD J2
SSP 30237E
140
120
100
80
60
.015
.1
1
10
50
FREQUENCY [MHz]

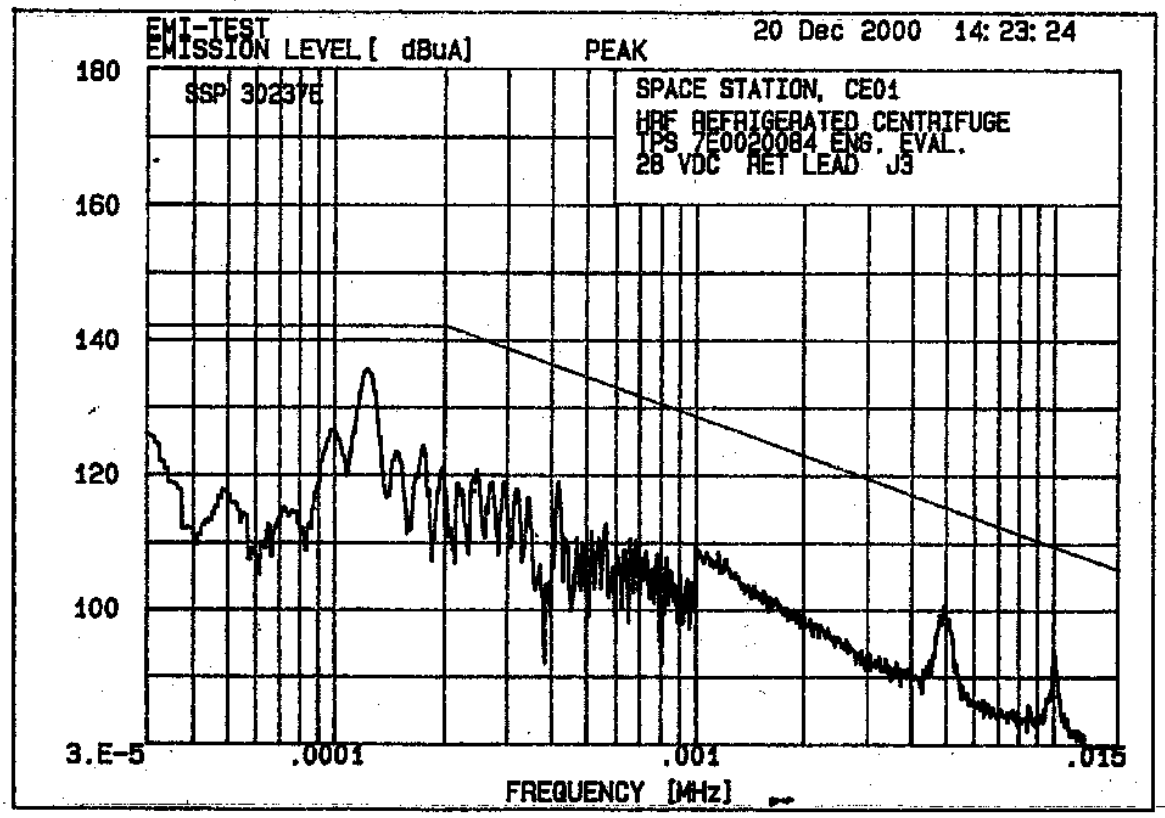
EMI-TEST 20 Dec 2000 14:15:47

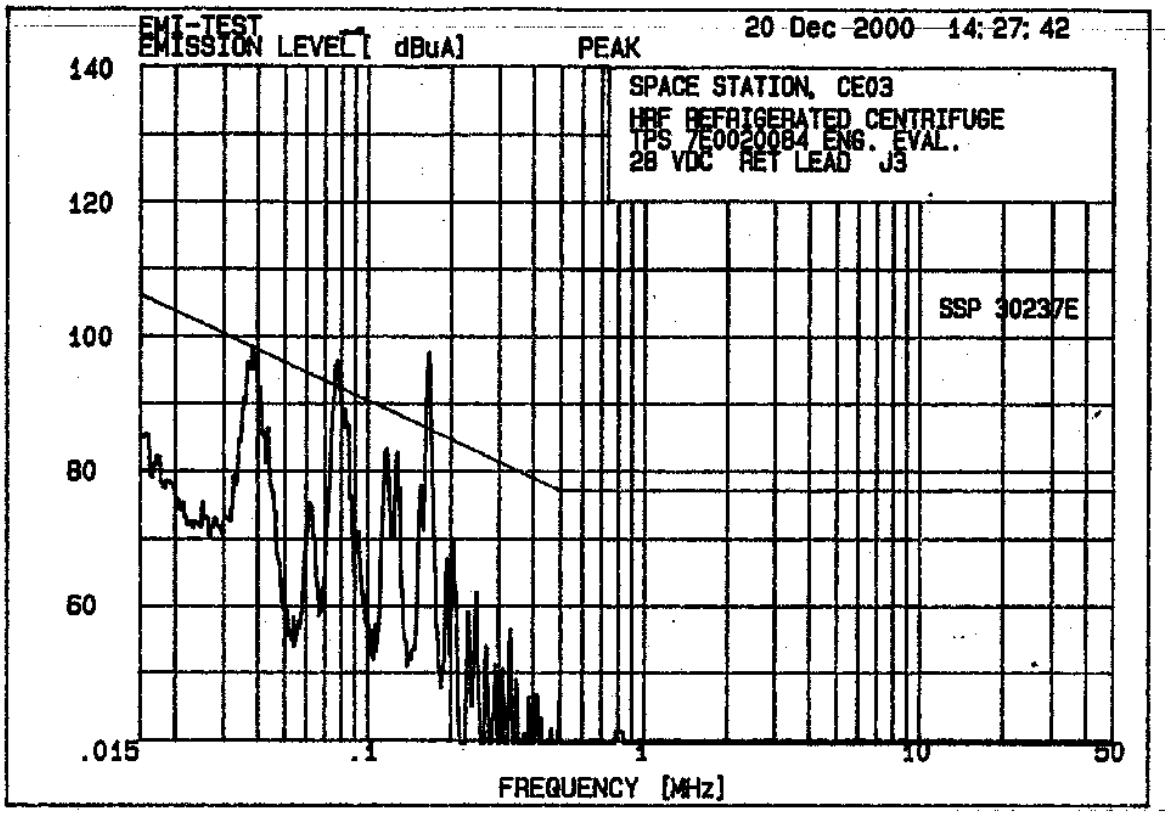
1. SPACE STATION EMISSIONS TESTS
   1.9 SPACE STATION, CE03

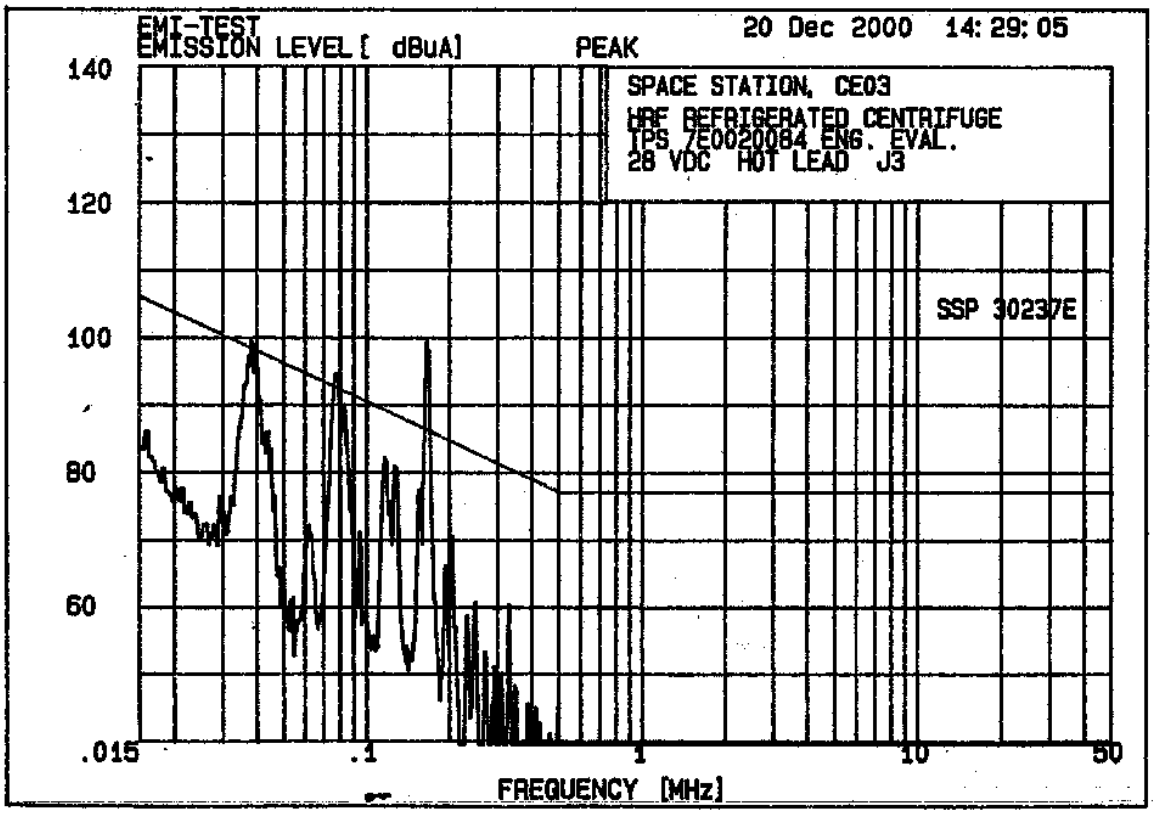
Peaks above 0 dB of Limit Line #1
peak criteria = 3 dB

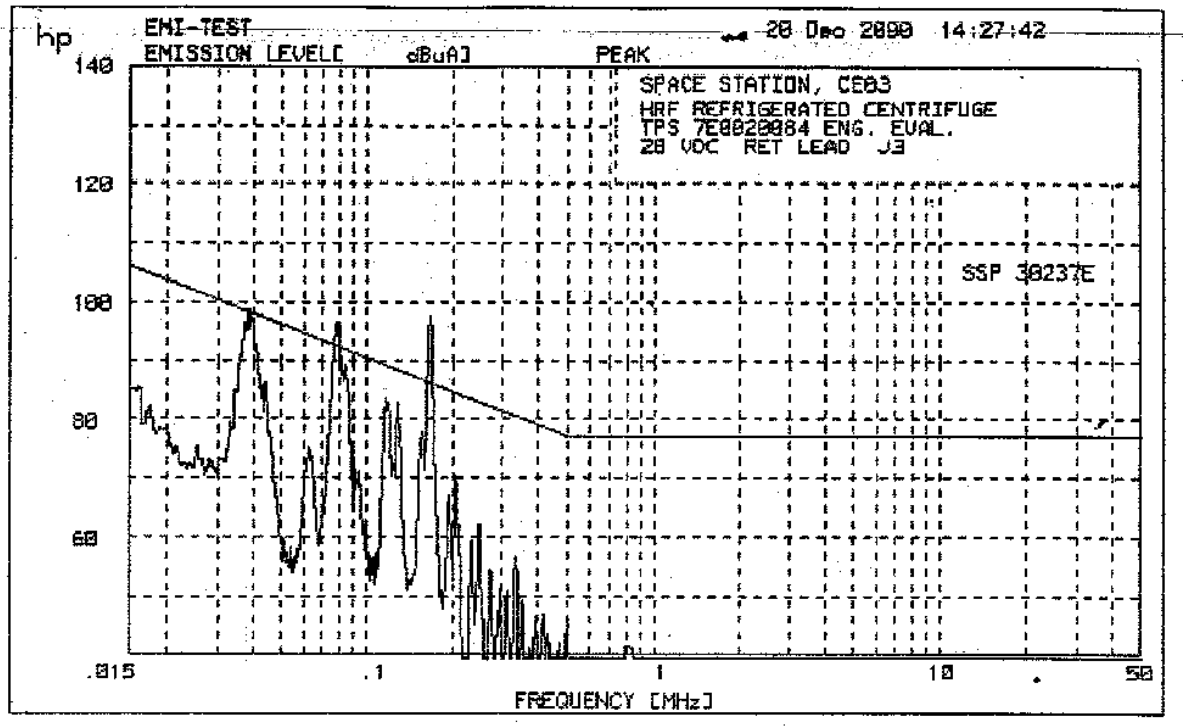
PEAK#	FREQ (MHz)	(dBuA)	DELTA
1	.0384	99.5	1.3
2	.07899	95.1	2.9
3	.1665	98.5	12.5


EMI-TEST
EMISSION LEVEL [dBuA]
PEAK
20 Dec 2000 14: 20: 12
SSP 30237E
SPACE STATION, CE01
HRF REFRIGERATED CENTRIFUGE
TPS 7E0020084 ENG. EVAL.
28 VDC HOT LEAD J3
180
160
140
120
100
3.E-5
.0001
.001
.015
FREQUENCY [MHz]


EMI-TEST
EMISSION LEVEL [dBuA]
PEAK
20 Dec 2000 14: 23: 24
SSP 30237E
SPACE STATION, CE01
HRF REFRIGERATED CENTRIFUGE
TPS 7E0020084 ENG. EVAL.
28 VDC RET LEAD J3
180
160
140
120
100
3.E-5
.0001
.001
.015
FREQUENCY [MHz]


EMI-TEST
EMISSION LEVEL [dBuA]
PEAK
20 Dec 2000 14:27:42
SPACE STATION, CE03
HRF REFRIGERATED CENTRIFUGE
TPS 7E0020084 ENG. EVAL.
28 VDC RET LEAD J3
SSP 30237E
140
120
100
80
60
.015
.1
1
10
50
FREQUENCY [MHz]


EMI-TEST
EMISSION LEVEL [dBuA]
PEAK
20 Dec 2000 14:29:05
SPACE STATION, CE03
HRF REFRIGERATED CENTRIFUGE
TPS 7E0020084 ENG. EVAL.
28 VDC HOT LEAD J3
SSP 30237E
140
120
100
80
60
.015
.1
1
10
50
FREQUENCY [MHz]

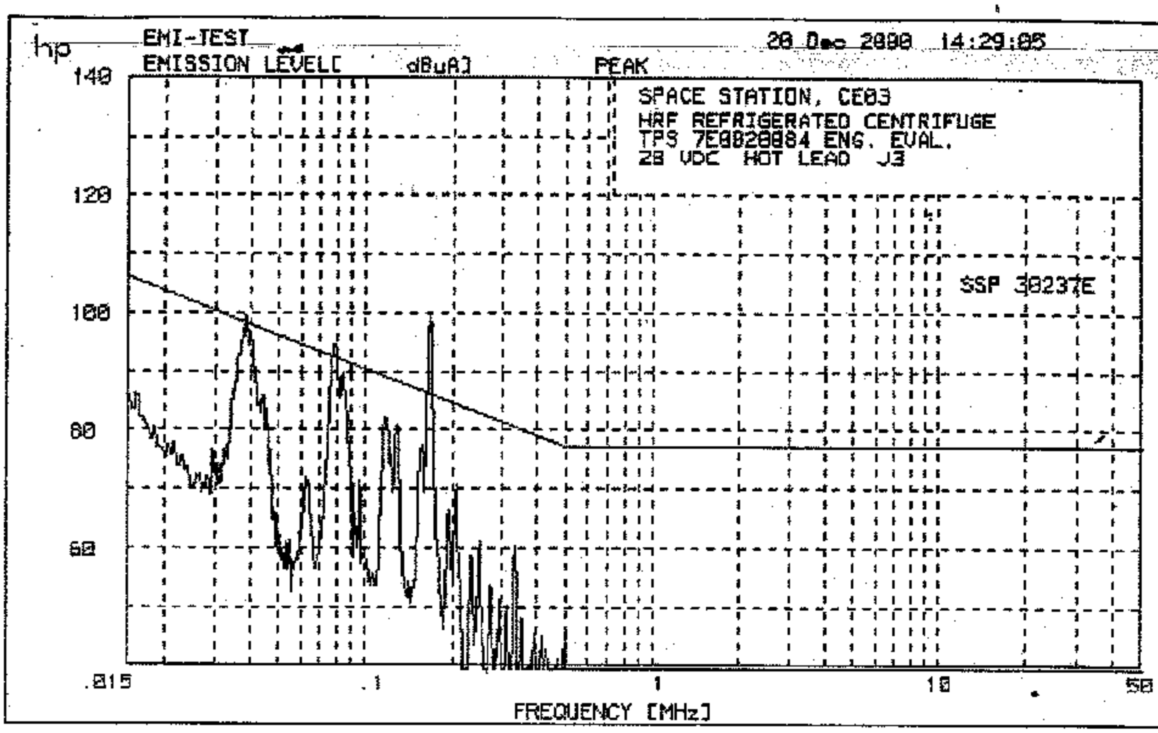

hp
EMI-TEST
28 Dec 2000 14:27:42
EMISSION LEVEL[dBuA]
PEAK
SPACE STATION, CE03
HRF REFRIGERATED CENTRIFUGE
TPS 7E0020084 ENG. EVAL.
28 VDC RET LEAD J3
SSP 30237E
140
120
100
80
60
.015
.1
1
10
50
FREQUENCY [MHz]

EMI-TEST 20 Dec 2000 14:27:42

1. SPACE STATION EMISSIONS TESTS
   1.9 SPACE STATION, CE03

Peaks above 0 dB of Limit Line #1
peak criteria = 3 dB

PEAK#	FREQ (MHz)	(dBuA)	DELTA
1	.0384	98.6	.4
2	.07835	96.3	4.0
3	.1678	97.6	11.6


hp
EMI-TEST
28 Dec 2000 14:29:05
EMISSION LEVEL[dBuA]
PEAK
SPACE STATION, CE03
HRF REFRIGERATED CENTRIFUGE
TPS 7E0020084 ENG. EVAL.
28 VDC HOT LEAD J3
SSP 30237E
140
120
100
80
60
.015
.1
1
10
50
FREQUENCY [MHz]

EMI-TEST 20 Dec 2000 14:29:05

1. SPACE STATION EMISSIONS TESTS
   1.9 SPACE STATION, CE03

Peaks above 0 dB of Limit Line #1
peak criteria = 3 dB

PEAK#	FREQ (MHz)	(dBuA)	DELTA
1	.0384	99.5	1.3
2	.07835	94.6	2.3
3	.1665	99.7	13.7